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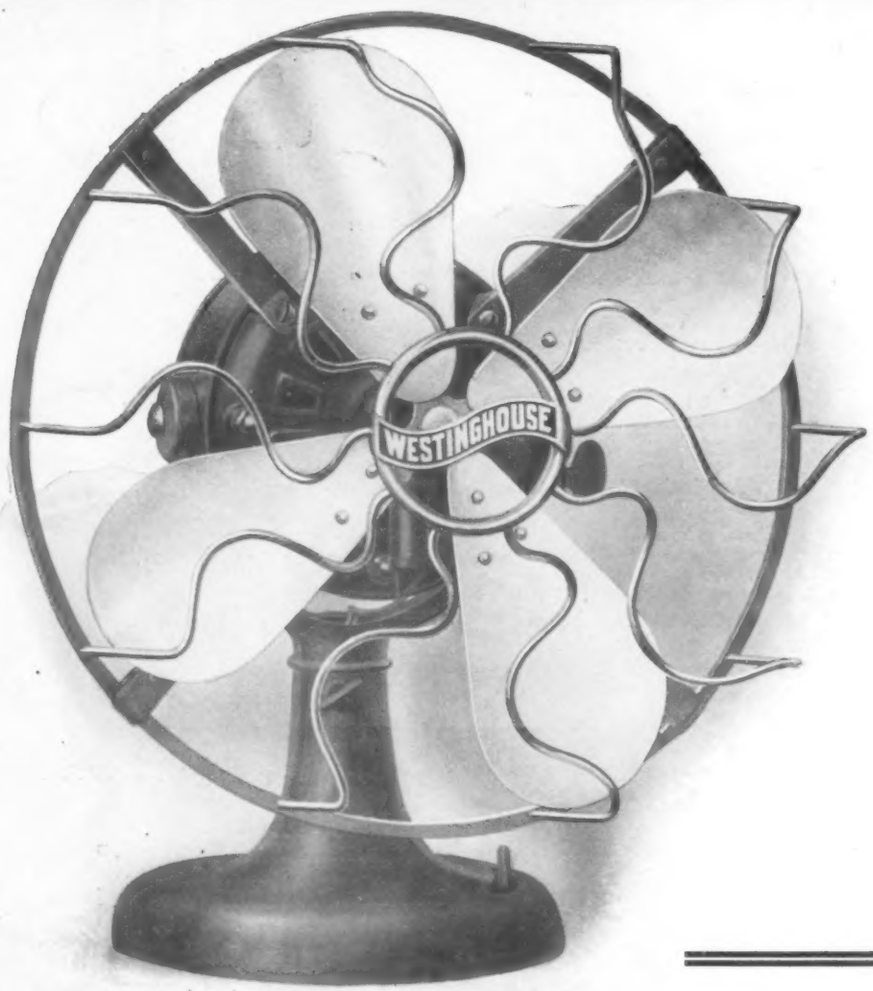

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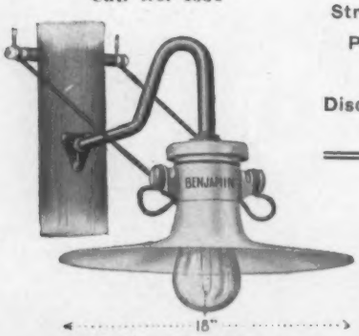

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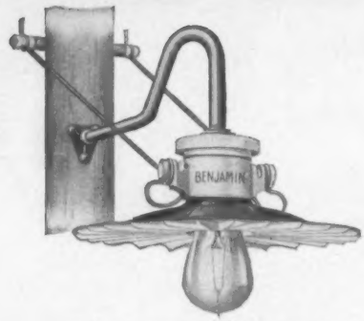

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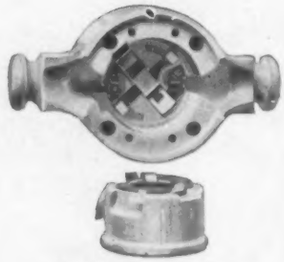
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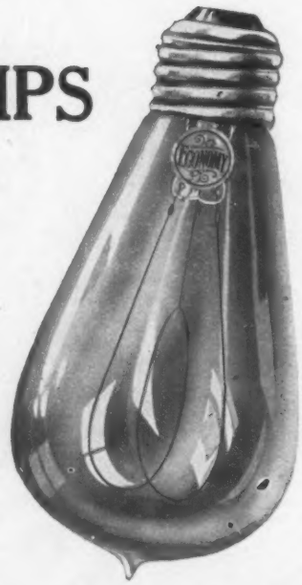

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POWER AND GAS
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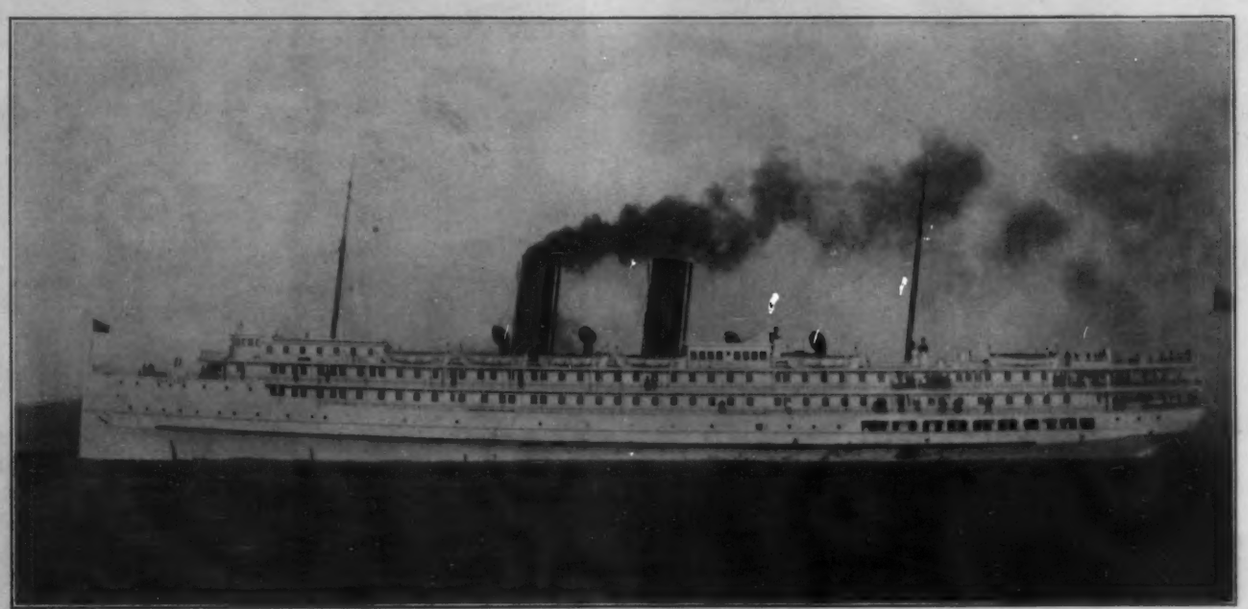
OIL BURNING TURBINE STEAMERS

The Pacific Navigation Company's steamships "Yale" and "Harvard" are triple-screw vessels, turbine-driven and oil fired. These steamers, which were formerly on the run between New York and Boston were brought around the Horn last year and are now running regularly between San Francisco and San Pedro, whence it is but a short ride by electric car to Los Angeles. The boats maintain an average speed of 22 knots, the trip being made in 17 hours.

first turbine driven vessels on the Pacific Coast, being among the first to be built in the United States. Though originally designed for burning coal, they were changed to oil-burners while yet on the Atlantic Coast, being the pioneers in this field. Besides the absence of soot and coal dust, the change made a great saving in space, reduced the firing force from 48 to 12 men and made possible a more even steam pressure and consequently more constant speed.

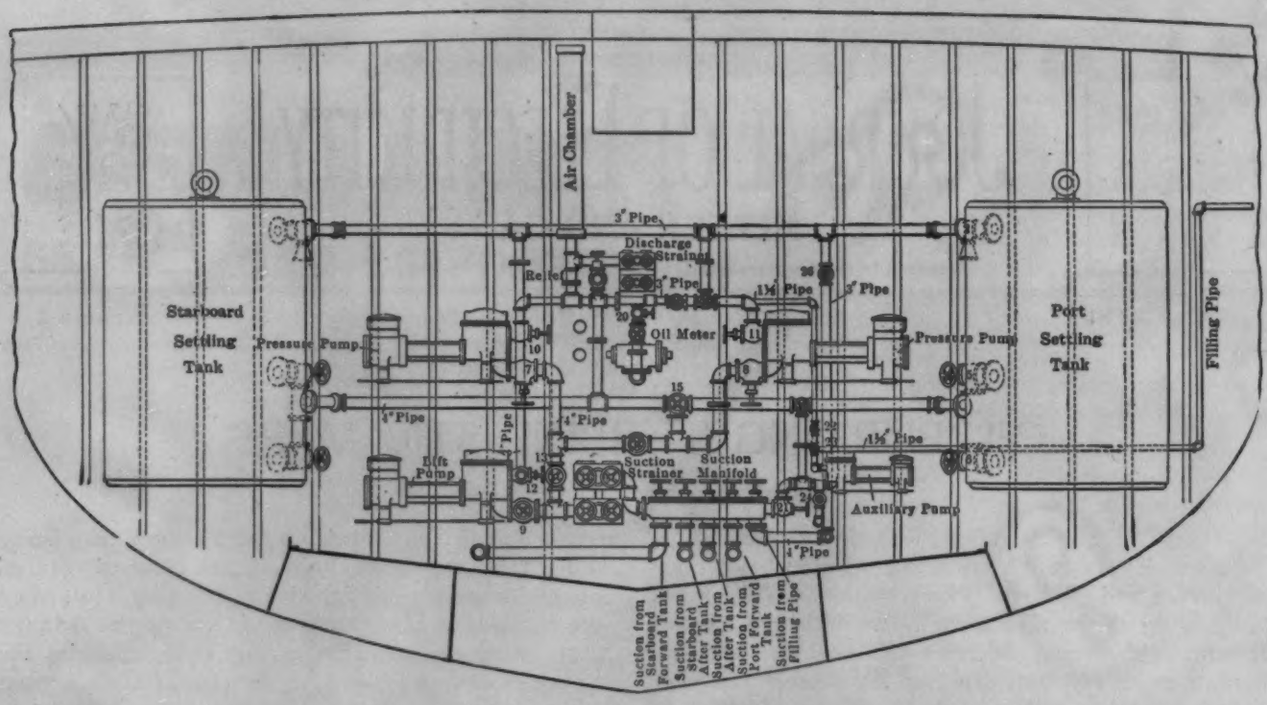


The Oil Burning Turbine Steamship "Harvard."

The "Yale" and "Harvard" are sister ships, a description of one sufficing for the other except for the blue furnishings of the former and the red carpetings and upholstery of the latter. The hulls were designed and the models tested at Denny's ship-yards, Dumbarton, Scotland, and the ships built at Chester, Pa. The turbines were installed and the super-structure completed in New York harbor in 1906. The dimensions are: length, over all, 407.25 ft., length between perpendiculars 386.5 ft., breadth over all 63 ft., breadth of hull, molded, 50.5 ft., depth of hull, 22 ft., gross tonnage 3721, net tonnage 2312. They have double hulls and numerous water-tight bulk-heads and are the

Every possible provision has been made for the comfort and convenience of the passenger and no expense has been spared in the interior fittings of the vessel which may be best described by the accompanying illustrations. The lighting is entirely by electricity and all rooms are equipped with electric call bells connected to a central annunciator system. A wireless telegraph system enables communication with land at all times.

The three-blade triple screws are driven at 480 r.p.m. by Parsons turbines, the high pressure stage driving the central screw and the two low pressure stages driving the other two, governors and automatic



Sketch of Oil Pumping System.

The Dining Saloon.

Courtesy Ocean Travel and Traffic

Grand Stairway Leading from Dining Saloon.

Stateroom With Private Bath, Aboard Yale and Harvard.

Men's Room on Hurricane Deck.

equalizing valves being provided so that the same amount of steam is admitted to the two low pressure stages. Reversing is accomplished by separate turbines placed in the low pressure casings. These turbines are capable of developing 12,000 h.p. and on its trial trip the "Yale" attained a speed of 24.32 knots.

Steam is supplied from a battery of twelve single-ended Scotch boilers, 14 ft. in diameter and 12 ft. long, there being two boiler rooms, separated by a watertight bulk-head and having three boilers on either side. Each boiler has three corrugated furnaces, 42 inches diameter, leading to separate combustion chambers. The original oil burners were of the Lassoe type, but soon after arriving on the Pacific Coast these were replaced by Staples & Pfeifer burners.

The oil is stored in four tanks in the double-bottom under the boilers, being supplied from the oil-boats through a 6 in. pipe connection. These tanks have a combined capacity of 110,000 gallons, sufficient for a steaming radius of 650 miles. As may be noted from the sketch showing the general arrangement of the oil pumping system, the oil is pumped from the storage tanks to two 3000 gallon settling tanks by means of a 9x5x10 in. duplex Warren suction pump whence a similar pump delivers the oil through a heater and strainer to the main 3 in. supply pipe which branches to each of the 36 burners. The piping is arranged so that the pressure pump can be used as a lift pump or the lift pump used as a pressure pump. There is also an auxiliary 5¼x3½x5 in. pump for port use when only one or two boilers are in service.

The boilers also supply steam for the turbine auxiliaries, the steam steering gear, a large ventilating fan, induced draught and two 50 kw. Sturtevant generating sets with vertical engines. The latter supply direct current at 110 volts for 1600 incandescent lamps, a 24 in. searchlight and a number of small kitchen motors operating a dish washing machine and a knife grinder and buffer.

A KNAVE OR A FOOL.

The following letter of application was received recently by an engineer of a local concern. It is given literally as received, except that, for the present at least, the names of the references are suppressed, and the names of the company addressed and of the author are fictitious:

"Atlantic, Pacific & Gulf Electric Ry. Co.,
"Gentlemen:—

"I desire to make application for employement as an Electrical Engineer with your company. My Qualifactions are as follows,

"Formerly, Engineer of Research, Brown & Biveori, 10 Cross Harper, London, W. C.

"Chief, Design and test room, Current and Pontential Transformers, Westinghouse Elect. & Mfg. Co., Pitsburg, Pa.

"Engineer of record, Detroit United Rys. Detroit, Toledo and Flint systems, Haugensraf, Lief and Haugensraf, (Single Phase System) B 466 Strauser Kiel, Berlin. Unted Manufactures 250 West 54th St., New York.

"University of California,

"University of Chicago,

"Age 35 yrs.
"Native California,
"Salery $4000 to $5000 per year.

"City reference .....
.....; .....

"Trusting my application will receive favorable consideration, I am

"Respectfully,

"A. F. RAUD."

Enclosed with the letter was a business card as follows:

A. F. Raud, S.B. Ph.D.

The combination of the uniquely illiterate epistle and the letters following the name on the card was so striking that an inquiry was started to ascertain how it was possible for a man to acquire such evidences of proficiency, inferentially along engineering lines, and at the same time to escape rubbing up against the rudiments of his mother tongue.

When the University of California failed to find any record whatever either of his matriculation or of any work he had submitted for his alleged degrees, he was requested to call at the office of the railway company for a personal interview. The conversation was recorded stenographically. He stated that he had entered the University of California with the Class of 1898, had attended the College of Philosophy for two years, and then the College of Engineering for a like period, under Prof. Cory and his assistant; that at the end of this course, in 1898, he had been awarded the degree of B. S. He failed to remember the exact title of his thesis, but in general it was a mathematical dissertation on differentials in transformer design. The thesis was submitted to Profs. Cory and Stringer, (Stringham?)

He stated further that after leaving Berkeley he was in the Westinghouse Electric & Mfg. Company, East Pittsburg works, and that later, after a year or two in Berlin and London, he took up special work in the University of Chicago under Dr. Lichistein (?) for which he was given his Ph.D. in 1902, his thesis being on "The upper and lower magnetics of rotary coverters."

Even with all this detail to guide their search, both the University of California and the University of Chicago, failed to find any record of his triumphal journey through their hands; the latter could not locate the Dr. Lichistein referred to.

Of course it may be that in both these seats of learning their departments of research into records that do not exist may not have been in full working order, but the chances are much more in favor of the hypothesis that his claims to large experience and to advanced educational standing are largely statements of what he would like to have done rather than what he did.

To lie once is easy; to lie persistently, consistently, is beyond even the gods of chance.

NECESSITY FOR VALUATIONS.[1]

BY HORATIO A. FOSTER.

During the last five years the fact that many public utilities corporations, notably street railways, have made only fair earnings, in a great many cases not enough to pay stock dividends or bond interest, has made people careful about putting new money into such properties, and it has been necessary, therefore, to make more careful valuations of such properties in order to insure the success of a new issue of securities.

It may be well right here to give some consideration to the condition of street railway properties and the reasons for the hesitancy of the people to put their money into the securities. Back in the early nineties, when the development of street railways was taking place at a very rapid rate and when promotion of the same was at its height, it was difficult to make company officials realize the fact that depreciation would take place sooner or later, and when their attention was called to the fact the officials and directors, together with the then stockholders, insisted that dividends be paid, and that provision against depreciation be deferred until the future; in fact, the saying was common: "Let the future holders take care of depreciation"; and within the last five years such depreciation has become so manifest in most of the large street railway systems that the officers have had great difficulty in keeping the property in operating order, and within the last two years, owing to the failure of so many roads which were very heavily overcapitalized, it has been extremely difficult to procure new capital for repairs or renewals of the roads, and many have had to go through the hands of receivers. Others have been reorganized, and by careful attention to details have weathered the storm and have come through the ordeal with greater or less success. It may be said, however, that in almost all cases arbitrary arrangements for transfers have so eaten into the earnings that it is no longer profitable to extend the lines or to build new ones in order to prevent congestion of traffic, as they do not bring an adequate income, although adding to the expense of operation.

All these conditions have added to the necessity for valuations and in a great many cases nowadays where the properties have to be re-organized, either through the hands of receivers or otherwise, a valuation of the property, both tangible and intangible, will be found positively necessary in order that the new securities may have a proper basis of issue. For instance, the Public Service Commission, second district of New York State, replied to one application for re-organization to the effect that no re-organization which did not bear some relation to value could ever stand, and that a re-organization in which the present earnings were inadequate to pay interest on the existing bonds was hardly a good foundation upon which to base a further increase of securities.

It is probable that the most notable case of valuation of any public utilities property, and the earliest which created any public interest, was that of the Chicago railways. In this case, the city had, for a long time, been fighting the railways for increased and better facilities, and had gone so far as to declare for municipal ownership, but an agreement was finally reached after many years of quarreling, whereby the railways agreed to go into company with the city, and a valuation of all the physical properties of the company, together with the unexpired franchises, had to be made as a starting point for the combination, in order to form a basis upon which securities could be issued.

Since that time many valuations have been made, notably those of the roads in New York City and Brooklyn, those in Toledo, Cleveland and Detroit, and in all cases both the value reproduced new and the present, or depreciated value, have had to be determined.

It may be said that the appraisal of the physical or intangible property is ordinarily made for one of two reasons; viz.: for sale, or for the adjustment of rates. Where the valuation of the property is made for sale, only the present, or depreciated value, can be accepted, and it is a comparatively easy though rather tedious matter to make a complete inventory of the property and apply present-day prices to the same. It is another question, however, to determine the depreciation upon the property, and that will be treated further in this paper.

As regards the valuation of electric lighting plants, this has only been necessary in case of the properties of a new organization, or for some English syndicate which desired to know the value of the equipment upon which they were taking the securities; and, again, for rate cases where prices have been reduced arbitrarily by some law or ordinance and the companies have been dissatisfied with this reduction and have taken the matter into court.

In modern times, when the subject of a new rate is brought before a court, about the first question asked is: "What property have you upon which you wish to earn a dividend?" and the court pays little, if any, attention to the amount of capitalization upon this property; it therefore becomes necessary for the company to determine this value, both for the tangible and intangible property.

Many valuations of water-works and water-powers have been made in the past, until the methods and rulings have become quite well settled as to most points, so that in the older States, such as New England and New York, the laws covering such valuations have become more or less stable; the points have been determined and technical questions no longer are troublesome.

At the last session of Congress the question of actual physical values of railroads was taken up, and there can be little doubt but that in the near future the determination of such values will be absolutely required in order that the new laws relating to the issuance of securities for railroads may have a proper basis; and furthermore, care must be taken to show all the property, both tangible and intangible, at its proper value. I can, perhaps, do no better than to quote from Mr. Roosevelt's speech on Decoration Day, 1907, at Indianapolis. Mr. Roosevelt said:

"At the outset let it be understood that physical valuation is no panacea; it is no sufficient measurement of a rate; but

[1] Abstract of paper read before Los Angeles Section American Institute of Electrical Engineers, Oct. 25, 1910.

it will be ultimately needed as an essential instrument in administrative supervision. * * * Therefore the physical valuation can never be more than one of many elements to be considered; but it is one element, and at times may be a very important element, when taken in connection with the earning power and business possibilities in reaching an estimate on the property and rights of a corporation as a going concern.

"The effect of such valuation and supervision of securities cannot be retroactive. Existing securities should be tested by the laws in existence at the time of their issue. This nation would not more injure securities which have become an important part of the national wealth than it would consider a proposition to repudiate the public debt. But the public interest requires guaranty against improper multiplication of securities in the future."

A true valuation must not only show the market value today of the physical or tangible property, but different percentages must be added for overhead charges, such as contractors' profit, engineering and superintendence, organization and legal expenses, interest during construction, insurance during construction, contingencies, discount on bonds, and in many cases, a percentage must be added for working capital. All of these (in some cases amounting to at least 25 per cent), must be added to the actual physical values in order to make a correct appraisal of the tangible property of the company.

A complete appraisal, exclusive of the above overhead charges, should show the separate total values for the following:

(A) Cost to reproduce new.

(B) Present value, which means the depreciated value.

(C) Physical development charges.

The above values may be used for:

(A) Rate making.

(B) Sale and transfer of property.

(C) Bond issue.

(D) Total capitalization.

(E) Establishing a uniform system of accounting.

In addition to these it may at times be necessary to make an additional study of values when considering improvements and extensions needed to provide adequate service.

The Cost to Reproduce New.

For this purpose it is necessary to take an itemized inventory of the entire tangible property and apply to each class a unit cost which shall represent the cost of labor and material as of the date at which the inventory is taken. Exceptions should be made, of course, where such unit costs are obviously unfair, due to unusual market conditions or to difficulty of obtaining material such as is in service, but which is no longer manufactured for the purpose. For instance, copper, in the last five years has had a great variation in price, ranging from 13 cents to 27 cents a pound. In the case of electric light companies where extensions have been necessary and they have been compelled to purchase copper at all these prices, it is hardly fair to use the price of today, which may be low, or of tomorrow, which may be high, in determining the value of the commodity which does not depreciate in value as a metal. In such cases it has been customary to take an average price for a number of years, say five.

Each item of the inventory should be considered as reproduced new in the exact form found and the value of the new material of like kind determined. The unit price of all this material should be determined on the basis of a sub-contract in order that the contractor's profit may be added to the total. This profit will ordinarily be ten per cent on all items of a construction nature, but usually should not be added to equipment items, such as the rolling stock in railways, and of course this contractor's profit should not be added to physical development items. Another percentage should be added to cover incidentals, city inspection, organization and engineering—though this percentage does not apply ordinarily, on real estate. A percentage of this sort may be divided into three parts; one-third to cover incidentals, contingencies, incomplete inventories, city inspection, etc.; one-third to cover cost of taxes, organization—such as general office expense, superintendence, etc., and another third to cover cost of engineering.

Present Value.

Present value is determined after consideration of the scrap value, original service value, obsolescence, inadequacy, wear and tear, deferred maintenance and remaining service value. Almost all physical property is worth something as scrap and this value cannot be depreciated; therefore, in determining the present value of any property it is necessary to deduct the scrap value from the value covering reproduction of new in order to determine that portion of the value which is to be depreciated. The scrap value is merely a fair market price less the cost of turning it over to the purchaser. The original service value will be equal to the difference between the cost to reproduce new and the scrap value.

Obsolescence may be described as a decrease in value due to change in the art; such a change as has taken place in steam plants in recent years due to the construction of the steam turbine, which, in many cases, has compelled the abandonment of reciprocating engines long before they had been worn out or become inadequate, simply to save the difference in cost of fuel and labor. Obsolescence can be applied to overhead wires where only the insulation wears out and wires can be added to from time to time, at comparatively low cost. They must, however, be put upon the basis of being compelled, in the near future, to be placed in conduits under ground, in which case the overhead wires must be very much decreased in value, and at times have to be sold for mere scrap. This is one of the most difficult items to determine in connection with an appraisal, and it always results in some arbitrary rate of depreciation being set by the engineer in charge, after long discussion with owners of the property and with their engineers. The application of this rate to the elapsed life of the original service value last mentioned equals the deduction to be made for obsolescence. Where there are parts which are already obsolete, of course only salvage values should be allowed.

Inadequacy applies particularly to street railways in which tracks have to be torn up and sold for second hand or for scrap owing to the fact that the rails are no longer heavy enough to support the cars which have been bought to replace the smaller cars which are no longer adequate and for which the public loudly demands a substitution. There are probably few things in which substitution has gone on more rapidly than it has in the street railway business; in fact, one of the items calling for a decision by the Supreme Court and by many commissions is, what value shall be given to expenditures for property which has entirely disappeared. For instance, in the early days of electric railroad installation, the purchase of the horse railway meant simply the purchase of the right to build an electric line, for in no case was the track heavy enough for electric cars, nor was it of proper construction; the car barns were only good for storage of a few empty cars, and never large enough for the newly developed property. The horse barns were abandoned or used for storage purposes only, and the horses were sold for what they would bring, leaving nothing but the right of way in the street, over which rails could be laid by the new company; thus at a stroke, the value of the first property disappeared. An important question is: "Should value be given to the property which was purchased and thrown away, and if so, what amortization of that property should be charged off, so that in time, after proper re-organization, the stock or securities issued would equal only the value of the new property which was and is in existence?"

Wear and Tear of any part is the normal deterioration of that part due to service, the action of the elements and accidents. This must be offset eventually by the regular repairs. A depreciated condition of the whole property will always exist from this cause, due to the fact that wear and tear on the system as a whole occurs gradually and continuously, and will be offset gradually, and not all at the same time. It is obvious that the cost of renewals and repairs should be charged to operation. The amount to be allowed for wear and tear can be arrived at upon the basis of a percentage of the original service value on such class of construction, never in excess of fifty per cent, but it must be determined in each case by the ratio which the average age of the several units comprising the class of material in question, exclusive of replacements, bears to the estimated total life of this class of materials, when subjected to wear and tear only, always assuming the highest practicable maintenance. It may be assumed that the life of no class of materials will exceed one hundred years. This rule, of course, must not be applied to individual pieces of apparatus, but where many such pieces exist in the system, this so-called fifty per cent rule may be applied with much satisfaction.

Deferred maintenance results from neglecting all proper and regular renewals and repairs, and is, of course, measured by the expense necessary to offset such neglect. This expense should be charged to operation. The estimated cost of deferred maintenance on any part may be obtained by arriving at the expenditures necessary to bring that part up to good serviceability.

The remaining service value is found by subtracting the sum of obsolescence, inadequacy, wear and tear and deferred maintenance from the original service value, and the present value of the property is then equal to the scrap value plus the remaining service value.

Physical Development Charges: In the production of a property there may be certain expenditures required in its development apart from those clearly evidenced by the finished property, some of which should be wholly included in the cost to reproduce; others should be partly included, and still others should not appear at all, as they must be taken care of previously by amortization. These rules of expenditures may be described as follows:

Class A. Items, the total cost of which should be added to the cost to reproduce and upon which a definite estimate of cost can be made.

Class B. Items upon which only an approximate cost can be determined, or in regard to which the propriety of their addition to cost to reproduce may be questioned.

Class C. Items of such intangible nature, indeterminate value, improper expenditure or so antiquated as to prevent their addition to the cost to reproduce.

Now, a word upon the **going value** or **good will** of a corporation.

The Maine court has ruled that the "going concern" or "established business" is an element of structure value. It may be defined as the cost of establishing, up to the level of the net income of the old plant at the date of taking, the business of a similar new plant (but not of a more perfect system which the city might build), which is supposed to begin operation upon the date of the taking, the old plant going out of business at the same moment. Or, to put the same thing in another way, it is the measure of the greater value (at the date of taking) of an old established plant, over a similar new plant completed and ready for operation upon the date of taking. Or, to put the same thing in still another way, it is the measure of the cost of developing the business of a new plant to a point coincident with the net income upon the date of taking, of the old plant.

With the exception of a few cases which recently have been passed upon by the Wisconsin Commission, few electric light or electric railway cases have been decided in which a value has been set upon the good will or going value. It is obvious that the going value may exist even after the franchise has expired, if the plant continues operation and continues to serve the community. This value was recognized by Justice Brewer in the decision of the Supreme Court of the United States in the Kansas City Water Works case. The following is the language used:

"The city steps into possession of a property which not only has the ability to earn, but is in fact earning. It should pay, therefore, not merely the value of a system which might be made to earn, but that of a system which does earn."

It is seldom, however, that any two or more indi-

viduals agree upon the method of determining the going value or good will of a concern upon which an appraisal has been made. A recent compilation of twenty appraisals shows a variation in the value of the good will of 0 to 47 per cent of the value of the physical property of the plants. In fact, in an important recent appraisal, of the five leading specialists making the appraisal, no two agreed upon the method of computing the value of the good will.

In the purchase of properties of various companies by English syndicates, their method for determining the value of the good will is to take the value of the net earnings of the corporation under consideration for one, two or three years, as a measure of the value of good will. A greater amount than the income for three years has, in some cases, been taken; in fact, the writer knows of one case where a valuable business was purchased and where five years' net income was taken as the value of the good will.

Reference has been made to some of the decisions of the Wisconsin Railroad Commission, and it may be well to quote one or two of them:

In the Cashton Light & Power Co. case: "The element of "going value" created by the investments made in developing the business and in addition to the cost of the physical structure must be taken into consideration in fixing value; although the franchise of a public utility operating under an indeterminate permit has expired upon the exercise by the municipality of its option to purchase, the plant is to be taken over as a going concern; and just compensation must be awarded for the property taken as a living and operating entity, engaged in serving the public, and not as a mere plant without patrons and without privilege or right to operate and to serve the public and having but a salvage value."

Also, in the Antigo Water and the Marinette Telephone cases: "The theory of the Wisconsin pubilc utilities law is that rates shall be reasonable and shall be not greater than enough to yield a fair return on the investment. In determining the investment as a preliminary process to the fixing of rates, the commission had to deal with the claims of large "intangible" franchise values as well as "going values" in both the Antigo water case and the Marinette telephone case. Regarding the former, the commission holds that if the municipality required the payment of money or its equivalent, or there was necessary ligitimate payment made for the franchise, then the sum which may be reasonably said to have been paid for the franchise may be included in the valuation, the same as money necessarily invested in physical property. But the Commission refuses to consider the claims of some experts and corporations that franchises for which no money was paid may have "intangible" values which should be considered in the making of rates.

"It has been held by experts that "going value" should be allowed as so much per customer, or as a percentage of the receipts, and some have considered it of as great, if not greater, importance than the physical value of the plant. The Commission holds that the actual reasonably wise expenditure of money towards getting the business of the plant established may be included in the value to be allowed for the purpose of fixing rates. Since no plant pays at the outset, and the first years of operation are almost invariably accompanied by losses or necessary deficits, the Commission holds that such losses may be said to represent the cost of securing an established or going business, and as such may be included in the value or investment upon which the rates for public service shall be fixed. But the converse of the rule also holds, that is, if a plant has in the past earned more than a reasonable return, possibly through the toleration of excessive rates, the excess over reasonable earnings may, under certain conditions, be substracted in determining the present value of the plant. That is, a "going value" may be negative. In the case of the Marinette Telephone Company, for example, the Commission found upon its investigation of the financial history of the company that through a period of recent years the company had been enjoying a sufficiently high rate of return to write off the early deficits in so far as such deficits might be allowed as going value."

The method used by the Wisconsin Railroad Commission in determining the going value of gas and electric light plant in the case of the State Journal Printing Co., et al. vs. the Madison Gas & Electric Co., was as follows:

Beginning twelve years back; to the then earning value of the company was added, all additions to depreciable property, the increase in land values, depreciation at four per cent on the sinking fund basis, and interest at seven and a half per cent on the value: net earnings from operation for that year, giving a new value which was used as the earning value for the succeeding year. This process was carried on each year for twelve years, adding all the items mentioned above and subtracting the net income at the end of each year, thus arriving finally at a much increased value, which was called by the Commission the earning value of the plant at the end of the time for which the computation was made.

The writer has not as yet gone into the merits of this method, but all of the decisions of the Wisconsin Railroad Commission have been so fair as to receive the commendation of all parties concerned in them, and the commendation of engineers and appraisers in general; in fact it may be said that the decisions of this Commission have received more public commendation than those of any other Commission of recent years.

Franchise Values.

This is one of the most troublesome questions that comes before the appraiser and the values have been determined in a number of different ways. Perhaps that made use of by the Ford Franchise Commission in New York State has been carried the farthest. In this case an appraisal is made of the physical property of the company and to this is added the capitalization of the net earnings of the company, such capitalization being made at 2, 3, 4 and 5 per cent, according to the class of the city; this total is then called the assessed value of the franchise which is taxed, and it is this method which has been fought so long and hard by all public utilities corporations in New York State, and which has, in every case, been sustained by the courts, clear up to and including the Supreme Court of the United States, and the companies have had to compromise or pay according to this assessment. This, perhaps, is the best evidence existing to show a method of valuing a franchise.

Another method—that used in appraising the value of the franchises of the Chicago street railways—is to deduct from the gross receipts the usual operating expenses, including taxes, maintenance and renewals, which leaves the net receipts from operation; from this net is deducted interest at the current rate—say five or six per cent, which must include brokerage—on the capital; the remainder will represent the franchise value for one year. This value can be determined for a term of years by obtaining the present

value, or estimated future yearly franchise values, taking into account an estimated rate of increase of business.

Depreciation.

I shall begin this subject by quoting from two authorities; one the Supreme Court of the United States, and the other Professor Cooley, of the University of Michigan. The Supreme Court of the United States, in a decision rendered in the Knoxville water case, has the following to say:

"A water plant, with all its additions, begins to depreciate in value from the moment of its use. Before coming to the question of profits at all the company is entitled to earn a sufficient sum annually to provide not only for current repairs, but for making good the depreciation and replacing the parts of the property when they come to the end of their life. The company is not bound to see its property gradually waste without making provision out of earnings for its replacement. It is entitled to see that from earnings the value of the property invested is kept unimpaired so that at the end of any given term of years the original investment remains as it was at the beginning. It is not only the right of the company to make such a provision, but it is its duty to its bond and stockholders, and, in the case of a public-service corporation at least, its plain duty to the public. If a different course were pursued the only method of providing for replacement of property which has ceased to be useful would be the investment of new capital and the issue of new bonds or stocks. This course would lead to a constantly increasing variance between present value and bond and stock capitalization, a tendency which would inevitably lead to disaster either to the stockholders or to the public, or both. If, however, a company fails to perform this plain duty and to exact sufficient returns to keep the investment unimpaired, whether this is the result of unwarranted dividends upon over-issues of securities, or of omission to exact prices for the output, the fault is its own. When, therefore, a public regulation of its prices comes under question the true value of the property then employed for the purpose of earning a return cannot be enhanced by a consideration of the errors of management which have been committed in the past."

The elements of depreciation are admirably stated by Professor Cooley, as follows:

"1. Depreciation Due to Wear and Tear and Exposure to the Elements.—This is continuous. All elements have a wearing life varying with the element itself. No element can be completely worn out; it can be worn only to a point below which it becomes unsafe or no longer serves its original function. In practice the average condition of all elements must be maintained at a high percentage of the original cost if the property is to serve its purpose properly. This percentage varies from 75 per cent to 85 per cent of the cost now of the property. The difference between this percentage of from 75 to 85 and the original 100 is a depreciation which is inherent in the property and cannot be dispensed with. It must be met by a sinking fund, or its equivalent, otherwise this part of the original investment becomes lost.

"2. Depreciation due to Accidents, a Sudden Depreciation.—An engine or a boiler may be wrecked and with it other machinery. This might, and probably would, involve a considerable expense for repairs or replacement, besides possibly crippling the plant in part. Cars may collide or a car may drop through a bridge. A bridge itself may fall or be carried away by floods. A storm, as a cyclone, may work havoc, entailing costs in excess of those proper to be charged to ordinary maintenance of property.

"3. Depreciation Due to Inadequacy.—Cars suitable in the past had already been superseded several times by larger and better cars. This has rendered the track, structure and bridges inadequate, and as more power is required to propel the larger cars, the power plants have become inadequate. The public demand is largely responsible for this depreciation due to inadequacy.

"4. Depreciation Due to Obsolescence.—This, while closely allied to the depreciation due to inadequacy, is different in that it embraces changes due to advance in the art. More efficient and effective machinery has appeared, which must be substituted for the old to keep abreast of the times. For example, in steam engine practice the turbine has come into general use during the past five years and the art of steam turbines is at the beginning. Generators adapted to piston engine practice are not adapted to steam turbine practice and must also be changed. Boilers adapted to piston engine practice must be replaced to carry the higher pressure required. Condensers must also be changed to secure the better vacuum required to realize the full advantage of the steam turbine. Owing to the rapid disappearance of coal beds, the price of fuel must advance, and this presumably will, before many years, force the adoption of the gas-producer and the producer-gas engine. Water-powers are wisely being developed, but to utilize them requires the scrapping of large parts of the machinery in use at present."

In few cases do the parties in interest agree upon the amount or rate of depreciation to be charged upon different portions of property; in fact, in any group of engineers who are asked to set rates of depreciation upon various items or classes of items, it will be found that scarcely two of them will, in the same case, set the same rates of depreciation, and this can hardly be wondered at for the reason that circumstances enter so largely, for instance: Steam engines which, in the past, have lasted 25 to 30 or 40 years, are now cast out, owing to the invention of the steam turbine. Buildings which, under ordinary circumstances will easily last one hundred years, and for any ordinary purposes would last that length of time, become inadequate for ordinary business, and have to be replaced in 15 or 20 years by new and larger buildings of more modern construction.

Going a little way from our subject and applying this to large buildings in New York City, the instance of the Plaza Hotel is perhaps one of the best in which a first class, modern hotel, of large size and splendid equipment, located at the corner of Fifty-ninth street and Fifth avenue, was torn down and replaced by a much larger and modern building, after a life of only 18 or 20 years, because it was found that the new structure would not only pay the interest on its own cost and the increased cost of the ground, but upon the cost of the purchase of the old building itself. Many other instances can be given of this, and yet, how would the rate of depreciation have been determined upon this very building ten years ago?

Coming back nearer to our own subject, the depreciation upon overhead copper wires will demand serious consideration in almost all of the larger communities, for the reason that as the city progresses, and demands more and better service, it also demands that the wires in congested districts be placed underground. These wires may have only been in place for ten or fifteen years although it is well known that copper itself will last for indefinite periods, and only the insulation deteriorates.

The old style arc lamps, which were good enough fifteen years ago have, in the last ten years, been en-

tirely superseded by the modern enclosed arc, which is now being superseded by the magnetite type of lamp.

In the case of transformers, ten or fifteen years ago only the smaller types were in evidence, while today the large sizes are more frequently put into use, and whole districts are lighted from centers of distribution, rather than from individual transformers. What rate of depreciation is to be put upon the value of transformers of the smaller and older types?

There are several methods of applying rates of depreciation:

(A) The Straight Line Method.
(B) The Sinking Fund Method.
(C) The method of a flat percentage chargeable each year against the value of the plant.

The first, or straight line method, is merely the charging off each year of a certain stated amount, which is the proportion of first cost, determined by the years of life arbitrarily set upon that part of the plant, against which the depreciation is charged.

The second, or sinking fund method, is the setting aside, at interest, an amount which, at the end of the term of life set upon the plant, will equal the total value of that part of the plant depreciated.

The third method is to charge against the value of the plant at the end of the year a certain percentage, which has been settled upon by the owners, and which can be charged for many years without reducing the value of the plant to zero.

EXCHANGE OF NEW BUSINESS IDEAS.

There is now in active operation from coast to coast, a thoroughly working exchange system of advertising and publicity between the large electric companies of the United States and Canada. This exchange was brought into being about the first of the year through the efforts of Mr. F. D. Beardslee, commercial engineer for the United Electric Light & Power Company of St. Louis, Mo.

Mr. Beardslee's idea is to put some twenty or more of the largest central stations of the continent in automatic communication with each other in regard to the publicity campaigns which they are carrying on in their respective territories.

The list at present includes fourteen of the largest companies. Its working, as arranged by Mr. Beardslee, is as follows: The man in charge of the advertising of the company mails a duplicate copy of every new piece of publicity, including all new advertising matter used by him in newspapers, magazines, pamphlets, novelties and follow-up letters, to each of the other members of the exchange. In this way each company has the benefit of every idea originated by every other company in the exchange. The system is working successfully and that it will probably grow to include many more members. At present those who represent the fourteen companies in the exchange list are:

Mr. E. W. Lloyd, general contract agent, Commonwealth Edison Co., Chicago, Ill.; Mr. Howard K. Mohr, advertising manager, Philadelphia Electric Co., Philadelphia, Pa.; Mr. T. I. Jones, general sales agent, Edison Electric Illuminating Co., Brooklyn, N. Y.; Mr. L. D. Gibbs, advertising manager, Edison Electric Illuminating Co., Boston, Mass.; Mr. Jos. P. MacSweeney, assistant commercial agent, Rochester Railway & Light Co., Rochester, N. Y.; Mr. C. H. Peirson, advertising agent, Southern California Edison Co., Los Angeles, Cal.; Mr. John O'Toole, publicity department, Public Service Corporation of New Jersey, Newark, N. J.; Mr. J. E. McKirdy, advertising manager, The Alleghany County Light Co., Pittsburg, Pa.; Mr. C. N. Duffy, general sales agent, Milwaukee Electric Railway & Light Co., Milwaukee; Mr. M. J. Connely, advertising manager, Denver Gas & Electric Co., Colo.; Mr. B. C. McNabb, New Business Dept., Montreal Light, Heat & Power Co., Montreal, Canada; Mr. H. J. Gille, commercial agent, Minneapolis General Electric Co., Minneapolis, Minn.; Mr. George Williams, care Messrs. Henry L. Doherty & Co., 60 Wall street, New York City; Mr. F. D. Beardslee, commercial engineer, Union Light & Power Co., Twelfth and Locust streets, St. Louis, Mo.

ORGANIZATION AND DISCIPLINE.[1]

BY M. C. RORTY.

I will try to give you an outline of the general principles of organization and discipline, together with some notions as to detailed methods of handling men. Let me begin by drawing a parallel between the development and handling of an organization and the design and operation of a steam engine.

In the case of the engine, the designer who made the plans would provide a cylinder and piston rod and cross-head and a connecting rod and crank. He would select the material for each with an eye to its special qualities, and would give each part dimensions proportionate to the demands to be made upon it. He would also give each part special functions, and would define in his own mind, down to the smallest detail, the duty that each should perform in the operation of the engine as a whole. He would never throw a tangle of material together, and turn steam into it, in the hope that it would grow into an engine.

And when the engine was completed and turned over to the engineer to run, (this in my parallel, representing the change from the development to the routine handling of an organization), the engineer would not say, if a bearing began to squeak and grow hot, "Good bearings do not squeak," for he would know that it was the nature of bearings to squeak, but would set to work at once with wrench and oil can until things ran smoothly again. He would know, too, that the more power the engine was developing, and the harder piston rod pushed against cross-head, and cross-head against connecting rod, and connecting rod against crank, the more chance there would be for friction. But he would not, for that reason, shut off steam. He would realize that if quiet and rest were all that were wanted, a turn of the throttle would secure that.

And if, in some way, the piston rod should begin to grow, and should say, perhaps, that the connecting rod was weak and that it would be better for the piston

[1] Abstract of paper read at the University of Wisconsin, Madison, Wisconsin, and printed in the Wisconsin Engineer.

rod to take hold of the crank directly, the engineer would not say, "Very well, fight it out." He would know that that would probably result in injuring or wrecking the machine. As a sensible engineer, he would say, more probably, "Very well, that may be so, but the designer and I will have to consider the question before any change is made. In the meantime, remember that you are still only the piston rod." And if the piston rod did not take the hint, he would find a new piston rod that believed in organization, and that he could safely trust alone with the rest of the machine. He would do this even if he believed that the connecting rod was weak and was not required in the engine.

Leaving this parallel as it stands, let me next state briefly certain fundamental principles of organization and discipline.

These are:

1. Each position in an organization should have assigned to it definite responsibilities and definite authority. These may, and, in most cases, should be reduced to writing.

2. Active responsibility should always be coupled with corresponding authority.

3. No change should be made in the scope or responsibilities of a position without a definite understanding to that effect on the part of all persons concerned.

4. No dispute as to the authority or responsibilities of a position should be considered too trivial for careful adjudication. The knowledge that this adjudication can always be obtained will tend to reduce friction and to promote amicable adjustments of differences.

5. An official in charge of any work, whether competent or incompetent, must insist upon his decisions as to methods of handling work being respected and followed out by his subordinates. A good man will give all possible weight to the opinions of his subordinates and, as he gains confidence in their judgment, will leave many points entirely to their decision. He will thus retain good men in his service. A poor man, on the other hand, will decide arbitrarily and will not delegate definite responsibility to his subordinates. He will, therefore, be unable to retain good men in such positions.

6. The work should create the position rather than the reverse. When questions of personnel make arbitrary divisions of responsibility necessary, unusual care must be taken accurately to define the limits of authority.

7. A sure appeal to men for extra exertion can only be made on the basis of their self-interest. To this end the organization should make full provision for filling, from its own ranks, any vacancies that may occur. The security of position which a good organization gives to its officials makes them ready and willing to give their subordinates full information of a kind to fit them for advancement.

Appeals to the loyalty of subordinates to superiors, or to "stockholders," will soon prove futile if accompanied by no prospects of advancement or increased remuneration.

8. The most certain guarantee of a loyal and enthusiastic working force is the adoption of a definite and logical policy, consistently carried out. The opportunist may occasionally achieve success for himself but he acquires few followers.

The principles that I have just enumerated apply equally well to all organizations without regard to the nature of the work involved, whether this be the making of steel rails, the selling of groceries, or the maintenance and operation of telephones. When, however, we come to study the characteristics of particular organizations we find that, in addition to these general principles, there are many other special factors to be considered. Among these might be named the geographical distribution of the working forces, the possibility of minute subdivision and specialization of the fundamental work of the organization, the presence or absence of broad natural lines of cleavage extending throughout the work of the organization, the character and extent of facilities for transportation and communication, the necessity or absence of necessity for local one-man authority, etc.

Leaving now the broader problems of organization, I will try to give you a few points as to detailed methods of handling men.

In the first place you have all heard of the old recipe for cooking a rabbit, in which it is specified that you must first catch your rabbit. So in handling men you must first learn to hire them.

Now I firmly believe that experimental psychology in time will develop to a point where it will be of definite value in selecting men for particular lines of work, and incidentally in determining courses of school and college instruction for individual students, but during your time as executives it will, I imagine, be necessary as today, to rely for such purposes largely upon the cruder psychological processes of personal judgment.

In my own selection of men, I first consider the work I have in mind and, if possible, choose a man who, while specially qualified for the particular work in view, is of so well balanced a make-up that he can, it necessary, be shifted to other work. This is important even in large organizations, and is doubly important where only a few men are employed.

In the second place, I am as careful not to pick too intelligent a man for a job as I am to secure a man that is intelligent enough, and, in determining this point, it is necessary, particularly in hiring young and ambitious men, to know with a fair degree of accuracy what, and how many, lines of advancement are open in the organization. As a general rule, the men you employ will have a rather fair minded view of their own capabilities, and of what is a proper rate of advancement, and you will secure best results by having neither a surplus nor a deficit of talent. I sometimes think that it is better, on the whole, occasionally to be forced to advance a man to a position a little beyond his natural capacity, than regularly to have an excess of highly intelligent men working in low grade positions.

And finally I never, when I can avoid it, rely entirely upon my own judgment either in hiring or in promoting a man. I have found, and you will find, that every man, consciously or uncon-

sciously, measures his intelligence against the intelligence of those with whom he is thrown in contact, and he does not do this fairly, point by point, but chooses his own strongest points as the basis of comparison. This principle is exactly the same as in trials of muscular strength, where the one proposing a test selects always some trick in which he is particularly skillful. So, in selecting an employe, I have him judged, whenever I can, by a number of persons of known and varied mental characteristics, and from their combined opinions find it possible, in the majority of cases, to make up a very accurate analysis of the man under consideration.

The determination of mental characteristics is, however, only a part of the proposition. I am inclined to think that my first instinctive measure of a man is based upon his appearance of health or ill health, and that I make judgment next for general normality or abnormality of makeup, and finally look for facial and other outward signs of perseverance and good tempered firmness, which are positive qualities and signs of strength, as distinguished from obstinacy which is a purely negative quality and a sign of weakness. And, unless an applicant measures up satisfactorily as to the points I have mentioned, I do not concern myself at all with the absolute degree of his intelligence.

With the proper man hired for a job and with the job properly laid out, two-thirds of the work is done, and the balance is simply a question of proper handling and discipline.

I specified near the beginning of this talk certain general principles for the handling of an organization and will supplement those principles now by describing more detailed and more personal methods of securing results.

To start with, there are as many kinds of men as there are of horses and, just as different horses require different handling, so the skillful driver of men will vary his touch for each individual. However, in all cases, you can make no mistake by keeping the personal interests of your subordinates in mind fully as much as your own, and, when you find your interests in conflict with the best interests of an employe, you will do well in the majority of instances to give precedence to his interests, and to secure your returns in the long run from the loyalty to you on the part of your subordinates that will follow the consistent carrying out of this policy. You must also treat your own authority as a thing so well established that you can afford to ignore minor breaches of discipline and to bear patiently with the augumentative man. Yet, on the other hand, when the time comes that the needs of your work call for definite and decisive action, and you have given all possible consideration to the suggestions and opinions of your subordinates, you must be prepared to enforce your decisions to the letter and without mercy to the obstruction. In such cases do not make the mistake of saying that you personally require certain things to be done, but say, rather, that the work requires certain action and that you, as the appointed agent of the work, will fire every last man on the job if necessary to get results. And in all your talk with your subordinates speak everlastingly of what the work requires and scarcely at all of what you personally desire.

In dealing with intelligent and sensitive men you must be an allopath in encouragement, instruction and judicious praise, and a homeopath in criticism. With unintelligent and shiftless employes, on the other hand, you must combine with these a wholesome fear of consequences, while to both types of workers you can apply, perhaps better than anything else, the stimulus of comparative figures as to results.

Now what I have told you may seem cold blooded and brutal, and it would be so, except for the fact that, when you have once demonstrated your entire willingness to perform a surgical operation on a crowd, if required for the cure of diseases of discipline, you will find that they will respond promptly to milder remedies. And, when you have brought this condition about and have tuned your organization up to concert pitch, you will be in the fortunate position where before removing a man, you can safely wait until his own associates are firmly convinced of his unfitness. Furthermore, by the judicious use of pace makers and comparative figures, you can readily develop a speed that will cause the majority of the unfit among your forces to drop out of their own accord into positions more nearly suited to their natural capacity.

I have told you now something of business organization and something of the ways in which men may be handled, but I have said nothing of what, to you as individuals, is a greater problem—the problem of self-development and self-handling. The average university graduate, when he begins his college course, has a productive value of perhaps $7 to $8 per week, and when his course is ended this value may have increased to $12 or $15 per week. In four years, therefore, the increase has been at the rate of less than $2 per week per year. Yet during the following twenty years of practical day by day experience, this increase for the ordinarily successful college man may continue at the rate of from $3 to $5 per week per year. This fact can in plain terms mean only that the effective man, each year after leaving college, learns more of productive value than he learns during the corresponding years of his college course. So when your time for graduation comes, do not think that your student days are over. You are simply changing schools and school-masters, and the peculiarity of Prof. Hard Experience, who will be your chief instructor, is that he teaches not so much what to do, as what not to do—and teaches the latter with a club.

To know what the college man should study after graduation, particularly if he hopes in time to take up executive work, it is necessary to know his special weaknesses. In respect to these I am quoting not only from my own experience, but from the experience of many others, when I say that the recent graduate is of an over-analytical turn of mind, has too much confidence in the goodness and honesty of human nature, and in general lacks absolutely the ability to see all sides of a proposition and to drive things to a conclusion without the turning of unnecessary corners.

These faults are in part the natural faults of youth and inexperience, but, to a greater extent, are due directly to certain perhaps unavoidable peculiarities of college training, and it is in one way not entirely fair to describe them as faults, for they continue as faults after graduation only when untempered by proper

observation and study. Nevertheless, it is a frequent and thoroughly distressing experience, when assigning a recent graduate to a definite line of work, to have him seize upon some comparatively insignificant feature of the job and analyze it to death, while at the same time, neglecting utterly a dozen more important features.

The college man, first of all, needs perspective and breadth of view, and, following that, needs a knowledge of men, and, to become strong in both of these directions, it is necessary, not only that he shall study his job from the bottom up by personal experience in his daily work, but that he shall also study it from the top down by reading and by taking every opportunity to talk of the work with those who are in position to see the broader aspects of it. Also, in studying men, it is necessary for him to know and study not only the men with whom he is thrown in daily contact in his work, but also to meet and know the men who are what he hopes some day to be. It is, of course, impossible, in a large organization, for the higher officials to meet and know all or even a large proportion of the subordinate employes, but, in the various engineering societies and business associations that the college graduate may readily join, he will find, if not his own superior officers, at least men occupying positions of equal responsibility, from whom, if he goes about it in the right way, he can readily obtain invaluable information and often direct personal advice. In his own line of work, too, he will ordinarily be surprised to find how willing his superiors are to give him a chance to become acquainted with branches of the work other than those in which he is directly employed. Requests for opportunity to acquire such information may occasionally be refused, but I doubt if in one case in a thousand they will ever be resented.

In addition to the information that may be obtained in this manner, it is important that the college graduate shall avoid the reaction from the reading of books that seems, in ninety-nine cases out of one hundred, to follow the completion of a college course. In this I refer not alone to a failure to read books applying to the particular line of work in which the graduate is engaged, but more particularly to a failure to read those books that are of assistance in knowing men. The man who hopes to become an executive and to handle business problems, must, above all things, know the nature of mankind in general, and I believe that this knowledge can best be secured by a proper proportioning of time between the direct study of men and the indirect study of them through books.

In all that you have studied here at Madison, and in all that I have said to you so far today, the most obvious point in view has been the securing of material dollars-and-cents success. Yet I might quote both Huxley and the "Declaration of Independence" to you to show that this material success is but a means to an end, which end is the securing of a rational happiness for yourselves and your neighbors. And, in analyzing the means whereby this rational happiness may be arrived at, you will find that it is expressed by the product of your co-efficient of appreciation of the sanely good things of life, into your opportunities for the enjoyment of them. And you will find, too, that happiness is as contagious as melancholy, and that your opportunities for the sane enjoyment of life are measured mainly by the friends you make, and the leisure time you have, and in least part by the money you have to spend. So, if you arrive at a sane philosophy of life, you will recognize that, if your co-efficient of appreciation is zero, and if your friends are zero, and your leisure time is zero, the value of your life, as a whole, will likewise be zero, whether you multiply the preceding factors by tens of dollars or by millions of dollars.

And this question of ideals is not an academic one, even from a purely business standpoint, for I have repeatedly heard men in responsible executive positions say that, in selecting a man for important work, they always felt safer if they knew that he had fixed and sane views of his purpose in life, and that they distrusted men, however capable, who looked upon their work solely as a means for personal advancement, and had none of the artist's satisfaction in good work for its own sake well done.

Now, I have, perhaps, taken an unfair advantage of you by talking of the philosophy of life, after giving my paper the business like title of "Organization and Discipline," so I will conclude and, at the same time, will try to square accounts by turning over to you a ready made philosophy from Marcus Aurelius, who says—"Besides you will quickly go the way of all flesh. * * * Therefore, what ever the dignity of human nature requires of you, set about it at once, without 'ifs' or 'ands,' and speak always according to your conscience, but let it be done in the terms of good nature and modesty and sincerity."

Examination for electrician is announced by the United States Civil Service Commission on March 8, 1911, for the position of electrician in the Bureau of Standards at $900 per annum. For filling the position it is desired to secure a competent electrician qualified in the care, maintenance, and repair of station storage batteries, and skilled in "lead burning" as applied to such batteries. The Bureau has in connection with its electrical equipment 800 storage batteries, and mere experience with automatic batteries is not considered sufficient for the position. It is also desirable that the appointee shall have had experience as an interior wireman, in addition to having a good general knowledge of electrical work.

PRESERVATION OF WOODEN TIES.

There are now more than 70 wood-preserving plants in the United States. A number of the large steam roads possess expensive plants fitted to handle large quantities of timber in a very efficient manner. Nearly all treated cross-ties used by steam railroads are treated in closed cylinders permitting the application of pressure and designed to secure a heavy absorption of the preservative. The principal preservatives used were creosote oil, and, to an almost equal degree, a solution of zinc chloride. Many ties are treated with an emulsion of creosote oil and a solution of zinc chloride, and one road treated large quantities of its ties with a heavy injection of crude petroleum.

CORONA.

Discussion of paper abstracted by Professor H. J. Ryan before the San Francisco Section of the American Institute of Electrical Engineers, January 27, 1911:

B. C. Schipman: Professor Ryan stated that in an alternating circuit the ions were carried to and fro, and that the general tendency was towards the conductor, and that therefore there was a general total movement of the atoms that way. Wouldn't that also be true of a direct current? Then, if you had a high tension direct current wouldn't there be a gradual transfer as in electrolysis?

Professor Ryan: Yes. I probably should have been a little more explicit in touching on that matter, in calling your attention to the inherent difference in this connection between the continuous electric field and the alternating electric field. These fields have exactly the same figure or form. In the continuous field therefore naturally an ion, that is, the electrified particle of gas, say a positive ion, will travel through the field and ultimately will reach the negative conductor. The negative ion will ultimately in the same way reach the positive conductor because there is no reversal of the electric field. If the negative ion happened to be near the negative conductor when the voltage was turned on it would have to travel at first through a tube of force that would be enlarging; being near the conductor, the tube is narrow there, and it enlarges as it extends from the conductor. As the ion approaches the positive conductor the tube of force of the electric field in which it is moving is contracting. In the alternating current case there isn't time between the alternations for the ions to make the whole travel. Some of them can—those that happen to be near the oppositely charged conductor; but others will not; the distance is too great, and they only get across part way. Now, if in traveling in the direction of a concentrating field they travel no farther than they travel in the opposite direction they would oscillate back and forth in place, and they would never arrive at either conductor. It is known however that they all move up in an alternating field, by degrees at least, and concentrate around the conductor, and there they move back and forth. Probably they strike the conductor at the time it is at maximum voltage, reverse sign and are driven out again through the remaining half of the alternation; but we haven't much evidence or data as to the exact mechanism of this phenomenon. We all know that it is so in effect. It is surprising at first that the stock of ions should accumulate about the conductor, and are shuttled in that way back and forth in its neighborhood. We have the fact to begin with, and it must be caused by the ions making a greater journey through a given electric field in the direction in which it is contracting than in which it is expanding. It is a fact that high tension wires operating with alternating pressure do concentrate a stock of ions about them. That causes one to see that they must travel further at each alternation when they are going in the direction of the concentrating field. You can see that it is a matter of velocities, resistances and details of that sort. I believe that those who work on the kinetic theory of gases could account for the phenomenon.

W. A. Hillebrand: At the White Mountains Convention (July 1, 1910), Dr. Kennelly in discussing Dr. Whitehead's paper, called attention to the very fact that Mr. Ryan has just mentioned, the fact that a charged particle may tend to move with an increasing velocity towards a converging field. And I would say, in addition, that he merely called attention to that likely fact at the time, and also raised a query, that is, he wanted to know whether or not this would play some part in the corona phenomena that had been observed.

Professor Ryan: To my mind, then, Dr. Kennelly has already anticipated the real cause of the concentration of a stock of electrified air about the conductors of an alternating high potential transmission line.

A. J. Bowie: Has the velocity of the wind had any effect on the sub-corona losses?

Professor Ryan: I have no direct evidence as to that. That is one of the interesting things to study in connection with corona and sub-corona atmospheric losses. I do not know. I was not able to come across any definite evidence in connection with that point anywhere, and I have no reasonable basis of conjecture as to what the effect of wind to a moderate extent would be.

B. B. Beckett: What relation has the diameter of the conductor to these convection current losses? I believe the smaller the wire the lower would be the voltage. It has been rather encouraging in considering the possibility of transmitting at some future day very heavy loads to long distances and using very large diameters and very high voltages. It looks now as if we were going to get into another difficulty, because, if I understand it correctly, this convection current would be greater in the large conductor than in a small one. Is that right?

Professor Ryan: I am glad you bring up that point. I should have spoken of it. The evidence is quite clear that the convection current loss depends largely upon the stock of ions that can be accumulated in the neighborhood of the conductor; there is some evidence that this stock is increased somewhat by the size of the conductor, and the intensity of the electric field about it. Loss by corona may be avoided by increase in the size of the conductors; loss by convection cannot be eliminated by the same expedient. Such convection loss becoming serious at high altitudes and high voltages, may undoubtedly be greatly reduced by lowering the frequency where that is practicable, otherwise the voltage must be limited to the economy value whereat the higher costs of operating at the lower voltage are fully compensated for by the convection current loss thus avoided. Indeed, it would be all the better if the direct current could be employed as some advocate in Europe, but I realize that this is looked upon as an academic proposition in our country.

C. F. Elwell: I remember that Professor Whitehead mentioned the result that by using Roentgen rays on the wire it made no difference to the critical voltages.

Professor Ryan: The agencies, and the factors that interfere with critical voltages, and what they are, will depend entirely, to begin with, on our definition of critical voltage.

Mershon at Niagara Falls took as his definition of critical voltage that voltage wherein the convection current loss becomes augmented by corona. Referring to Fig. A: Here is the convection current loss curve OaA that would be if corona did not come in. This curve is the inevitable loss under given conditions. If the conductors have a certain size, and are spaced a certain amount, and the altitude is at a certain value, and the temperature at a certain value, then we will get this loss O a b B and not O a A. Now Mershon in his work defined E^{I} as the critical voltage. I had defined E^{II} in my 1904 paper as this voltage, and I understand that Dr. Steinmetz in his corona work concludes that it should be taken at this same point E^{II}. Through my recent work and that of my colleagues, I have concluded that in the corona problem of the engineer neither of these should be taken as the critical voltage and that the critical voltage should be understood as I have taken it in this paper. One should define some such value like E^{III} as the critical voltage, that is, a voltage value wherein the corona loss has increased to such an extent that it equals the convection current loss. This critical voltage is definite, being only slightly affected by the electrification of the atmosphere.

The value that Dr. Whitehead has in mind is a laboratory value. This value is different from that obtained on the transmission lines, being about one-third greater. He uses the concentric cylinder apparatus. He exposes the atmosphere therein to X-rays (or ultra violet light—any powerful ionization agent) and the atmosphere enclosed in the outer cylinder is strongly ionized; but those ions travel through a balanced radial field, and they don't disturb appreciably the amount of the field.

About the high-tension line however, we have a field that is made up with a figure that you know quite well, its tubes

of force are drawn in Fig. 26 of the paper. The field right around the conductor is balanced through the depth of the corona, i. e. with distances apart of the conductors as they are used by the engineers, the field within the corona zone is just as uniform as it is about the central conductor in the laboratory apparatus. But it is totally different outside of such zone. Between the concentric cylinders, the ions travel back and forth in a balanced way, and they arrive at the surface of the conductor in a balanced fashion and produce a balanced result. To start that takes about 33 1/3 per cent more pressure because the electric field is not subject to distortion by an unbalanced movement of the ions. In the practical case the electrified particles collect from totally different volumes about the conductor. Out here is a big tube of force of enormous volume (Fig. 26) and within that volume occurs a far greater amount of electrified gas than in this tube; and you have arriving a much greater degree of electrification at some of these circumferential conductor elements than at others. Now traveling particles that are electrified constitute in effect a conductor, and they concentrate the field; the result is, we have in spots an increased stress in the air next to this conductor due to the concentration of the field upon the streams of electrified particles that are formed so easily in unbalanced fields and which act as conductors. The corona starts under those circumstances at precisely the same localized stress as in the laboratory case although the voltage is seventy-five per cent simply because of a 25 per cent concentration of the balanced field.

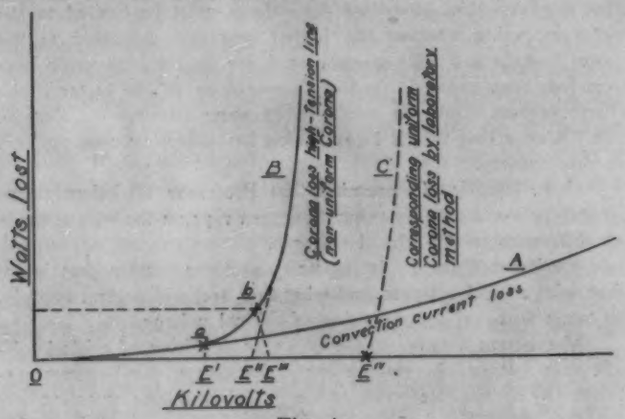


Fig. A.

In the practical case the voltage E', i. e. the Mershon critical voltage *a* varies considerably as the shock of ions varies; the voltage E'' locating the critical voltage *b* as used in this paper, varies but little as the shock of ions varies. The chief factor in causing the voltage values of the full corona part of curve *B* to be one-third less than those of *C* is the difference in the form of the electric fields, (see Fig. A.) This difference caused the formation of non-uniform full corona in practical case and uniform full corona in the laboratory case. Each is nearly independent of the amount of ionization present. The critical voltage point *a* is varied by changes in the shock of ions present and in the form of the electric field remote from the conductor, while *b, B, E* and *C* are changed materially only by changes in the form of the field.

A. J. Bowie: I understand from Professor Ryan the subcorona loss is proportional to the altitude above sea level?

Professor Ryan: Yes.

A. J. Bowie: And at sea level it disappears entirely?

Professor Ryan: No, it is very small, however, for engineering sizes of high tension conductors at the usual spacings.

Question; It might be quite a factor in the choice of the transmission line, either in valleys or over mountains?

Professor Ryan: Yes. There is much evidence that subcorona or convection current loss is a factor in the choice of routes at the higher altitudes.

S. J. Lisberger: Does there seem to be any tendency on the part of Mr. West and the others, or have you yourself considered the question of what might be the limit voltage of transmission lines, that is, taking only corona into consideration, and not considering switches, or leakage over insulators and so forth?

Professor Ryan: Yes, some engineers are making studies of this kind, and feel that there is a pretty early limit in the voltage on account of corona. By corona now we mean this general class of phenomena. You can see that if we have to use a No. 0000 conductor in order to operate at 155,000 to 160,000 volts to avoid corona at low altitudes (greater diameters at higher altitudes) that is a limiting proposition if we want to bring into a net-work the power of a small station, say 10,000 kw. capacity. That is manifestly above the limit of best economy. It would have to be larger, because it is near sea-level that a size like 4/0 must be had to avoid corona at 160,000 volts. This conductor must correspondingly be larger in diameter in the intermountain region, which is anywhere from 4000 to 10,000 feet in elevation; and the limit has of course naturally been attained in the Central Colorado transmission line. Frequency of course is a factor. If these net-works are going to grow (as they will of course) then it means that before long there will be a demand to put in trunking lines. You call the net-works buses often, and think of them as such, and you put your stations onto them to reach an effective market. By and by there will be a need of making trunking connections between these neighboring large net-works in order to interchange surplus power, i. e. to take in all power wherever it is to be had through the meter, and put it out wherever the market is found over always larger territories. And the question is, what voltage will be available for these trunking connections. Those will be the real long transmissions, and will carry pretty large amounts of power, but after all it will be only the surplus power that one net-work can spare another. An engineer, in connection with an extra long distance transmission line proposed the use of 300,000 volts. At the higher altitudes the convection current loss at such voltage at certain seasons of the year is likely to be altogether prohibitive; that is, the evidence points that way. And I believe undertakings of that character, or undertakings that are leading into practice of that character, will be enormously benefited by every engineer who make measurements of these losses and reports them.

Professor Ryan: Such a transmission will require a very careful preliminary survey, to determine how best to bring it

S. J. Lisberger: In other words, when you get to 300,000 volts you have got to have a subway.
about.

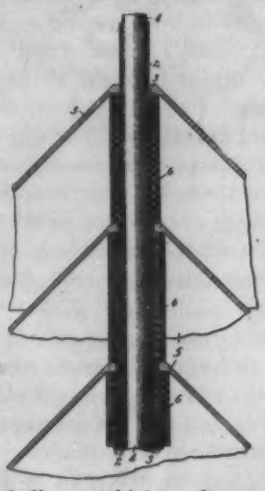
COMMERCIAL SECTION, N. E. L. A.

The Commercial Section of the National Electric Light Association has started an active campaign to extend the uses of electricity in all branches of industrial work and is also actively soliciting membership among central station employees. In accordance with its purpose of improving commercial practice and gathering data on allied subjects committees have been formed with members all over the country. These committees include those on sales, electric vehicles, wiring and equipment standards, residence business, advertising, sign lighting, electricity in rural districts, industrial light, membership, power, street lighting and competitive illumination.

Data and any one or all of these subjects is available to members, who are free to ask for any information they desire. This membership is open to employees of central stations, manufacturing companies, jobbers, dealers, contractors and engineers and costs $2.50 per year in addition to association membership. Application blanks may be obtained from any member or at the office of this journal.

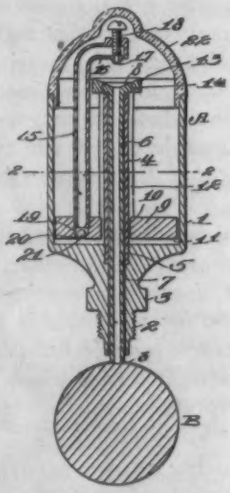
PATENTS

984,156. Insulating Structure. Arthur B. Reynders and Jesse E. Mateer, Wilkinsburg, Pa., assignors to Westinghouse Electric & Manufacturing Company. An insulating bushing, comprising a plurality of concentric cylinders of conducting material, separating cylinders of insulating material



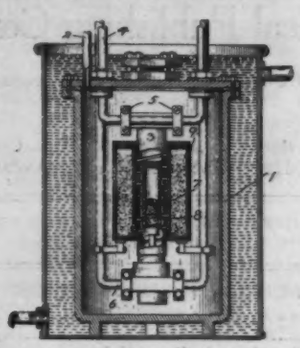
and overhanging bells or skirts of conducting material mounted upon the exposed ends of the cylinders in electrical contact with the conducting cylinders, said cylinders being graded in length between the inner and the outer surfaces of the bushing.

984,373. Lubricator. John Edward Hughes, San Francisco, Cal. In lubricators of the type set forth, the combination with a movable part having a cam surface of an oil cup, and pumping mechanism therein including a reciprocatory lubricant supply plunger having a portion projecting beyond



said oil cup and engaging said cam surface, said plunger supplying lubricant to said movable part, a pumping piston in said oil cup, means for connecting said piston to said plunger for movement therewith and means operable during the action of the piston to conduct lubricant to said plunger.

984,119. Electric Furnace. Howard I. Wood, Schenectady, N. Y., assignor to General Electric Company. In a furnace, the combination of an evacuated chamber, a graphite resistance heater within said envelop subject to disintegration when in normal operation, and a closed envelop inclosing the furnace charge and separated from said heater by an

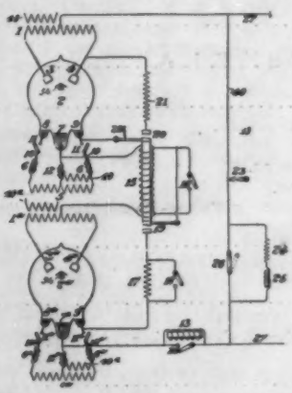


evacuated space, said charge-in-closing envelope consisting of material capable of chemically uniting with such carbon vapor as crosses said space.

984,297. Electric Meter. William H. Pratt, Lynn, Mass., assignor, to General Electric Company. In an alternating-current meter, a magnetic core forming a nearly closed magnetic circuit having a central member and two members each

joined at one end to the central member and at the other end separated therefrom by a small air-gap, a potential coil on the central member, a second magnetic core having poles disposed opposite to said air-gaps, and series coils on said poles.

984,248. Means for Starting Vapor-Converters in Series. Percy H. Thomas, Montclair, N. J., assignor to Cooper Hewitt Electric Company, New York. In a system of electrical distribution, the combination of a plurality of rectifier bulbs operated in series each bulb having two main anodes, two supple-



mental anodes and a cathode, and supply and load circuits and connections therefor, with separate means for each rectifier for passing current continuously between the supplemental anodes and the cathode, together with starting connections external to the bulb between the source which is connected with the main anodes and the supplemental anodes.

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POWER AND GAS

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NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office *ten days in advance of date of issue.* New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas." Weekly.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

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Efficient Technical Expression

The technical man is often bantered because of his clumsiness in expressing thoughts in words, the layman forgetting that there are languages other than words far more efficient for special purposes. Given a draughting board and pen, such a critic would be awkward in expressing his notion of the proper design for a power plant; provided with a list of chemical symbols or a table of integrals, he would find difficulty in interpreting a chemical reaction or calculating transient electric phenomena; furnished with a violin, he might lack the ability to express his emotions in music, or equipped with a brush, he could not paint a picture on canvas. The engineer, the chemist, the mathematician, the musician and the artist are specialists whose thoughts can best be conveyed by these vehicles which excel mere words as the automobile outspeeds the wheelbarrow.

But the technician must sometimes talk, as the automobilist must sometimes walk. Thoughts must often be conveyed by words instead of by more efficient symbols, just as an hydraulic jet may be better adapted to lifting water than is a centrifugal pump. The problem then resolves itself into an attempt to get the best possible result out of a machine inherently inefficient.

We divide output by input to find efficiency. Inefficient writing therefore gives the reader few returns as the result of his reading. An ambiguous sentence does not transmit the full power of the writer's thought; inappropriate words create friction in the reader's mind whose inertia cannot be overcome by a diffuse style. The most efficient composition is one with concise sentences forcefully written to overcome brain inertia and lucidly worded to lubricate mental friction.

The fault lies not entirely with the writer, for there are some readers who get little return from the best literature because their effort is inefficiently applied. Everyone knows the man who continually makes mistakes because he does not follow instructions, no matter how clearly they have been given. So there are readers who are unable to get the full value from an article simply because they have not learned to read properly.

Contracts and specifications are the most common subjects for engineering authorship and often the most glaring examples of careless writing. A well-written letter of application for a position is an excellent introduction; its converse a poor recommendation, as is well indicated in this issue in a case where a man's illiteracy betrayed his false pretensions.

A nobler and more profitable field lies in the opportunity that writing affords in relating valuable experience for the benefit of co-workers, incidentally displaying the author's fitness for similar work and thus gaining him more lucrative employment. Reduplication of effort, trying the same thing that some former worker has proven impossible, constitutes the greatest cause of lost motion in technical progress. This needless waste can be eliminated by voluntary contribution from all workers to the common fund of knowledge which is ours by inheritance and which we should enrich for posterity.

PERSONALS.

R. D. Holabird of the Holabird-Reynolds Company is in New York City.

R. S. Chapman, an electrical engineer of Portland, left last Monday for St. Paul.

Sidney Sprout spent the past week at Merced on electrical engineering business.

C. Walter Jones, sales manager for the Holophane Company, is at San Francisco.

L. E. Sperry, manager for the Western Electric Company in Japan, is visiting San Francisco.

Leon Bly, secretary of the Tehama Light & Power Company, of Red Bluff, was a recent San Francisco visitor.

George B. Burbank, consulting engineer for the Comstock Pumping Association, arrived at San Francisco from Virginia City, Nev., last Monday.

Elam Miller, commercial engineer for the Pacific Telephone and Telegraph Company, has returned to his San Francisco office from the Northwest.

G. I. Kinney, Pacific Coast manager of the Fort Wayne Electric Works, has returned to his San Francisco office from a trip throughout the Pacific Northwest.

A. W. Vinson, at one time engineer for the Cutler-Hammer Mfg. Company, at their San Francisco office, has been transferred to the New York office.

I. C. Ashcroft, an electrical engineer of New York, has arrived at San Francisco on his way to Tokio where he will take charge of a large electric enterprise.

D. W. Shanks, general manager of the Trinity Gold Mining & Reduction Company of California and the Rio Plata Mining Company of Mexico, is at Los Angeles.

R. W. Van Valkenburgh, formerly treasurer for the Western Electric Company at San Francisco, has been appointed manager of the company's house at Dallas, Texas.

M. C. McKay, superintendent of the Stanislaus division of the Sierra & San Francisco Power Company and L. C. Hilfrick of Vallecito, Cal., were at San Francisco this week.

A. J. Myers, Pacific Coast district manager for the Wagner Electric Manufacturing Company, returned to San Francisco from a trip to the factory at St. Louis during the past week.

John Coffee Hays of Visalia, manager of the Mt. Whitney Power Company, and also taking an active interest in the carrying out of the La Grange development, was a San Francisco visitor during the past week.

C. E. Grunsky has been unanimously awarded the Norman Medal for 1910 by the board of directors of the American Society of Civil Engineers in recognition of his paper on "The Sewer System of San Francisco and a Solution of the Storm Water Flow Problem."

O. G. Steele, superintendent of the Siskiyou Electric Power & Light Company, arrived at San Francisco from Yreka during the past week. Extension of the hydroelectric system which transmits power from a plant on Fall Creek to Yreka and to Dunsmuir are contemplated. An appropriation of 150,000 miners' inches of the waters of the Klamath River was recently filed for record.

E. V. D. Johnson, manager of the Northern California Power Company, returned to his headquarters at Redding during the past week after visiting the San Francisco office. He said that he was expecting an ample supply of water for power purposes this year owing to the fact that the snow is lying on the mountains instead of being melted off early by warm rains, as was the case last season.

PACIFIC COAST JOBBERS' CONVENTION.

That success has attended the strenuous efforts of the local jobbers that the annual meeting of the national body be held in San Francisco is shown by the following letter:

Electrical Supply Jobbers' Association,

Gentlemen:—The following telegram was received by me today from the French Lick Springs Meeting, Indiana:

"Without opposition Chairman announced April twenty-fifth, sixth and seventh, Del Monte. Congratulations.

"CARRIGAN, HOLABIRD."

Very truly yours,

ALBERT H. ELLOTT, Secretary.

An active letter campaign paved the way for this favorable result, two samples indicating the committee's good work:

Go into the Hot Springs Meeting with California on your tongue and California in your smile. Place a gold line under the months of April or June in your calendar. Take your vacation next year in the Promised Land.

Listen to our Committee and they will lead you out of Egypt, across the mountains and the prairies to the land flowing with milk, honey, golf, motoring, etc.

The Grand Canyon of the Colorado will take you back through geological time.

The sequoias of our forests will sing for you as they sang before the Wise Men who followed the Star from the East.

The Hotel Del Monte will be your private residence for the season. Bring your wife, bring your family. Let your watchword be "ON TO CALIFORNIA IN 1911."

If you have cold feet bring them out here and we will warm them.

REMEMBER the date, REMEMBER the place, and REMEMBER that there is a good time COMING when the Electrical Men shall get together at DEL MONTE.

We are sending you some literature enclosed.

Very truly yours,

WILLIAM L. GOODWIN,
C. C. HILLIS,
R. D. HOLABIRD,
Committee Pacific Coast Jobbers.

Final Appeal to Reason.

Our pioneer ancestors drove ox teams across the plains in 1849. You are coming over the trail to Del Monte in a special train in April, 1911. You will have scenery by day—poker by night. Many are the little Overbagh brooks which are now yearning to trickle from the snow capped domes of the sky piercing Sierras, down your thirsty throats. Flowers yet in the bud will be stirred to bloom at the electric touch of your women folks.

As you sit in the French Lick Springs Meeting try to hear the roar of the Pacific, or the chant of the priest in the Spanish Mission of Carmel. If your spirit so moves you tap lightly on the point of the nose of him who says: "It is such a long distance I am afraid I cannot go." Remember we have here the orange tree that sucks its gold from the depths of the soil, but the tree that bears the crop of little hammers finds in California no congenial soil.

Come with wives, sweethearts, daughters. We will send you back safe, healthy and happy. Everything we do will be electrical all the time.

Very truly yours,

WILLIAM L. GOODWIN,
R. D. HOLABIRD,
C. C. HILLIS,
Committee of the Electrical Supply Jobbers of the Pacific Coast.

P. S.—Read the book we send by this mail.

"The book sent by this mail" was a sixteen page pamphlet giving all the reasons why the meeting should not be held at Del Monte—the entire 16 pages were blank. All delegates at the French Lick Springs were decorated with a handsome badge giving a beautiful representation of the golden poppy, California's state flower. A large attendance is anticipated and a valuable session assured.

INDUSTRIAL

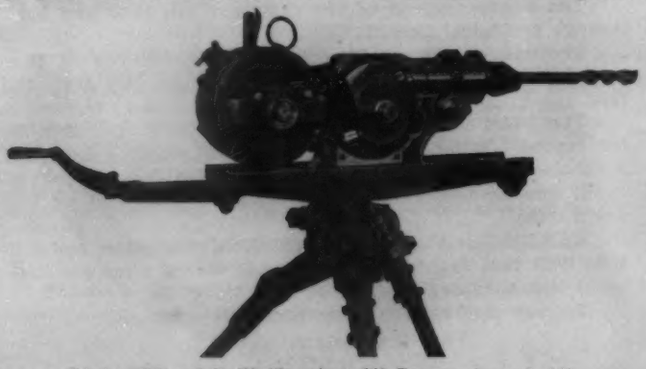
THE FORT WAYNE ROCK DRILL.

The Fort Wayne Type "A" Electric Rock Drill is the result of several years' development and testing under the most severe and unfavorable conditions of actual working operations.

It is a well-known fact that successful appliances can only be developed upon sound, well-founded principles, and experience has proven that the more simple the fundamental principle, the more successful the developed product—this is the keynote in the success of the Type "A" Drill.

Contrasted with other designs making use of flexible shafts, solenoids, springs and other complicated devices, the Fort Wayne drill is unusually simple; consequently it is made exceedingly rugged and effective.

The drill is of the rotary hammer type, operated by an electric motor which is mounted on the frame of the drill proper. The mechanism of the drill consists of two parts,



Right Side of Drill Showing Oil Reservoir and All Covers in Place.

a revolving helve containing the hammers, and the chuck mechanism for holding and rotating the drill steel. An idler is conveniently arranged in connection with the flexible belt between motor and drill, which provides a means of regulating the speed of the drill. Thus all the advantages of hand-drilling are obtained without the disadvantages incident to machine drilling.

The drill steel is held in the chuck by means of several spring steel plates. When not striking rock, the blow from the hammer is absorbed by these buffer plates, which also retain the steel in the chuck while "backing out" of deep holes or in broken and uneven ground.

The drill casing, striking mechanism, chuck and buffer plates are all simple and very substantial. The floating hammers in the helve are of special steel and are completely cushioned by air chambers so that the jar of the impacts is reduced to a minimum.

The drill steel cannot be jammed into a fissure or a cleavage crack as a result of several conditions. Should a fissure be encountered the buffer head prevents the drill steel from being plunged forward. The drill steel is not reciprocating and before it can be fed far enough into a fissure to wedge, it has hammered for itself a square shoulder or face, due to the rapidity of the blows in connection with the constant and positive rotation of the drill steel. The resultant effect approaches that of boring.

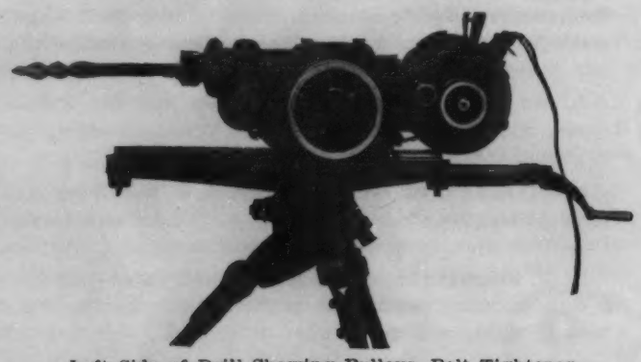
Another point of excellence in the Fort Wayne drill is the simple method employed for the removal of cuttings from the hole being drilled. A special designed steel, developed by our engineers, removes the cuttings by a boring action and does away with the use of hollow drills or water under pressure. Thus the big item of pressure systems, including tanks, hose, water lines, etc., is eliminated, to say nothing of the cost of maintenance and inconvenience incident to such systems.

While these drills are ordinarily used in a horizontal position, they can be used in any position and will drill holes at any angle.

The ease with which power can be transmitted throughout the workings by wire and the rapidity with which the lines can be changed enables the operator to advance his work more rapidly than could be done when using other types of drills.

A comparison of tests of the Type "A" drill and air drills shows that the former requires about 1½ to 2 h.p., including transmission loss, while an average air drill requires from 12 to 18 h.p. for the same work. This is due to the design of the drill, the much greater efficiency of the electric motor and the small loss in transmitting power to the drill.

The simplicity and ruggedness of design of the Type "A"



Left Side of Drill Showing Pulleys, Belt Tightener and Belt.

drill is a guarantee that the cost of maintenance will be exceedingly low.

Owing to the saving in power, the low cost of maintenance and the high efficiency of the Fort Wayne drill, from 50 to 70 per cent can readily be made, under ordinary conditions, upon the investment.

The drill can be operated with either an a. c. or d. c. motor and since the motor is entirely independent of the drill the change from one to the other is easily made. Bulletin No. 1120 from the Fort Wayne Electric Works gives further details about this drill.

AUTOMATIC FUEL OIL REGULATION EFFECTING STEAM POWER PLANT ECONOMY.

Practically all oil fired boiler plants are controlled by hand. Steam as well as oil is regulated at each individual burner, the dampers are also subject to hand control. Results obtained are hardly ever satisfactory, thereby lowering the efficiency of the boiler plant.

The first notable step in advance of hand firing was at the plant of the Pacific Electric Railway Co., Los Angeles, Cal., where under the directions of the Chief Engineer, one man stationed near the oil pumps, running at practically constant speed, controlled 18 boilers or 54 burners by opening or closing a bleeder valve on the oil pump discharge line, thereby increasing or decreasing the pressure in the oil main and simultaneously the rate of firing of all the boilers. After this it was a simple matter to substitute automatic regulation for hand control, thereby developing the Moore patent automatic fuel oil regulating system.

This system controls the supply of oil to all burners, the supply of the atomizing agent to all burners, and the supply

of air for combustion, for any number of boilers, all from a central point. The results are: increased boiler plant efficiency, the practical prevention of smoke, and the decrease in the maintenance cost of boiler equipment, due to a more uniform manner of firing. This was first installed at the Redondo plant of the Pacific Light & Power Company in 1907. Here the regulating system is used to control the entire plant of 18 boilers of 600 h.p. capacity each, and the increased economy, due to uniform rate of firing is evident.

Under actual operating conditions this system of regulation has been found absolutely reliable. In 1909 or about two years after this apparatus was installed, Mr. A. C. Balch, general manager of the Pacific Light & Power Company, expressed his opinion in the following letters to the designers:

"Referring to your inquiry, we are pleased to advise you regarding results with your automatic regulating system.

"As you know, we have in our plant at Redondo, 18 Babcock & Wilcox boilers, each rated at 604 h.p., with three burners per boiler, or 54 burners in all. The entire boiler plant has now been equipped with the Moore automatic fuel oil regulators for the past year, which control the steam pressure, the fuel oil pressure, the supply of steam to burners for atomizing the oil, and the operation of boiler dampers for the purpose of regulating the supply of air for combustion.

"With this system we maintain practically a uniform steam pressure while in operation. One-third of the plant has been under automatic control for a period of over 18 months. The remainder as stated above, was equipped with your regulators one year ago and the entire plant is now operating under this condition. During this time we have never suffered an interruption of service, or loss of steam pressure, due to failure of regulators to operate; they are simple in design and positive in action and we find them capable of ready adjustment by the operative firemen.

"Our plant is subject to a widely swinging railway load and we find under all conditions the boilers respond to these fluctuations of load almost instantly. As the result of installing this equipment we find the load is more equally divided among all of the boilers in service than under hand firing, and the boilers are free from abuses due to excessive rate of firing periodically experienced with hand regulation on variable load. It is usually the case, in attempting to hand regulate fires on reduced air supply, that the chimneys will smoke frequently on variation in loads; as a result of the automatic system of regulation, the smoke nuisance has been reduced to a minimum.

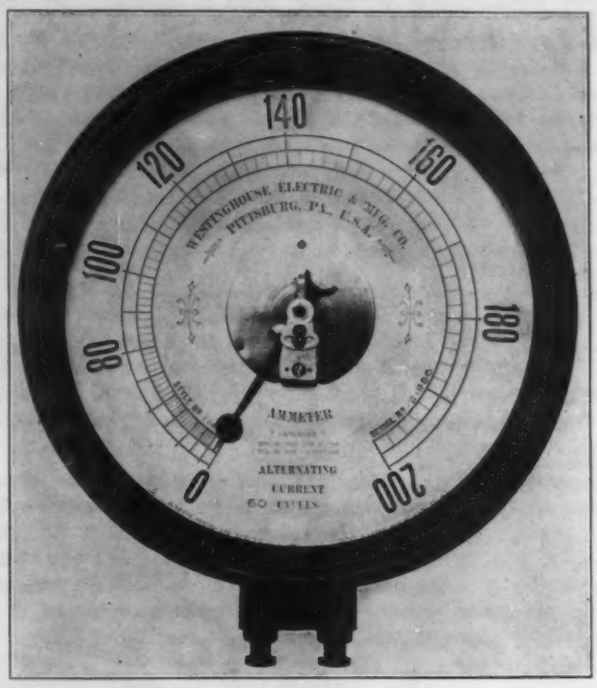
"We consider the regulating system thoroughly practical, reliable, economical in operation and a demonstrated success."

At this time, 1911, after this system has been in operation a number of years, the Southern California Edison Company is installing a similar outfit. This in itself is conclusive proof that this system tends to make the operating conditions ideal, particularly in the plants where the load is variable and difficult to handle by hand regulating on account of frequent adjustments. A bulletin "Unnecessary Losses in Firing Fuel Oil and an Automatic System for Eliminating Them" can be obtained at any of the offices of Chas. C. Moore & Co., Engineers.

LONG SCALE SWITCHBOARD METERS.

A meter with readings easily legible, for use in large installations where this characteristic is essential, requires a long and well illuminated scale. The long scale has been obtained by meter manufacturers in two ways. The simplest and most obvious way is to extend the pointer and the radius of the scale of a short scale meter until the desired length of scale is obtained. The other method of obtaining a long scale is to increase the arc subtended by the scale, a method involving a completely new design of meter.

It was this second method which was adopted by the Westinghouse Electric & Manufacturing Company in placing on the market their complete line of type F alternating current switchboard meters. These are round pattern meters of the usual size, about 9½ inches in diameter, with scales subtending an arc of 300 degrees and about 14½ inches long. The length of scale usually found only in the large illuminated dial meters is thus obtained in a meter of normal size. There is no metal front on the meter but instead a round glass cover is used. This makes it possible to thoroughly illuminate the dial from the front and thus avoid the use of special lamps.



Long Scale Switchboard Meter.

The meters operate on the induction principle. The torque depends on the action of a rotating magnetic field on a light, pivoted drum. This principle makes connections to the moving element unnecessary, and, by avoiding the use of a copper coil or iron core for the moving part, reduces the weight on the pivot bearings and consequently the friction. This leads to accuracy and long life. The moving element also has inherent damping qualities, and the torque developed is very high. The controlling springs, which balance the torque, are made of a special alloy, tempered and aged to insure permanence under all conditions.

The type F meters are furnished as ammeters, voltmeters, single-phase and poly-phase wattmeters, power factor meters, and direct-reading frequency meters. All of these meters utilize different forms of the induction principle. Type F single-phase and poly-phase static ground detectors are also furnished, harmonizing in size and general appearance with the rest of the line. The type B synchroscopes and the type FL direct current meters made by the Westinghouse Company are also of the same size and appearance, so that a complete harmonious switchboard can be arranged.

TRADE NOTES.

The General Electric Company has sold a Curtis Turbine to Sanderson & Porter for the use of the Grays Harbor Railway & Light Company at Aberdeen, Wash. The rating is as follows: One A. T. B. 4, 1250 k.v.a. (1000 kw. at 8-10ths p. f.) 1800 r.p.m., 2200 v., horizontal, condensing turbine generating set, together with one 25 kw. motor generator exciter set.

NEWS NOTES

INCORPORATIONS.

SAN FRANCISCO, CAL.—The Sierra Nevada Water & Power Company has been incorporated by C. A. Wright, Frank Smith, and E. McGettigan with a capital stock of $25,000.

GERBER, CAL.—The Gerber Water & Light Company has been incorporated by Edward H. Gerber, Geo. W. Peltier, F. W. Peltier and F. W. Kiesel, all of Sacramento, Cal., with a capital stock of $50,000.

VALDEZ, ALASKA.—The Mineral Creek Power Company, capital $500,000, has been incorporated by Joseph Bourke, F. M. Boyle, C. D. Shaw. The new company will soon begin construction work on a dam and power house. The dam will be 50 feet in height and will later be raised to 150 feet, giving 2000 horsepower. The company will also construct a customs mill to handle ore. The erection of an aerial tramway extending the length of Mineral creek is contemplated.

FINANCIAL.

SILVERTON, ORE.—The Silverton water bond issue to the amount of $75,000 has been carried, and C. H. Green, a consulting engineer of Spokane, Wash., has drawn the plans and will supervise the construction work.

ORLAND, CAL.—The Trustees has passed a resolution declaring their intention of calling a special election for voting bonds for municipal improvements. The date for the election will be fixed in the necessary ordinance, which will be introduced at the next meeting. The resolution segregates the bond issue proposed into $23,000 for waterworks and $27,000 for sewer system.

TRANSMISSION

EUGENE, ORE.—The Oregon Power Company is installing three new transformers in the new substation recently added to the present plant.

MEDFORD, ORE.—A plant at Prospect to generate 10,000 horsepower of electricity has practically been decided upon by Colonel Ray of the Rogue River Electric Company.

CHICO, CAL.—A power line has been constructed by the Sacramento Valley Power Company from this place to Butte Creek, several miles southeast of town, to furnish power for new dredges under construction.

EL PASO, TEX.—A permit for the construction of a $10,000 addition to the steel power plant building of the El Paso Electric Railway Company on South Santa Fe street has been granted to the Stone, Webster Co.

TURNER, ORE.—C. H. Cannon, local manager of Balfour-Guthrie Company, of Portland, Ore., has filed on the water rights of Mill Creek. He expects to develop from 1800 to 2000 horsepower for power purposes.

PORTLAND, ORE,—The Washington-Oregon Corporation has completed negotiations for taking over the plants of the Kalama Light & Power Company, the Rainier Light & Power Company, and the Kelso Light & Power Company.

KELSO, WASH.—The development of over 8000 horsepower at the falls of the Kalama river, where now there is only 600, the rebuilding of the 12 miles of power line from the power house down the Kalama river, and the construction of a power line from Kalama river through Kelso to Chehalis and Centralia, Ore., are some of the plans of the Washington-Oregon Corporation, states E. W. Hall.

MERCED, CAL.—The directors of the Exchequer Mining & Power Company held a meeting last week in the office of Dr. F. S. O'Brien the secretary and manager. The situation as a result of the recent floods in the Merced River Canyon was gone into and it was decided that the new powerhouse to be erected should occupy a different site than was occupied by the building destroyed by the floods.

ILLUMINATION.

BOISE, IDAHO.—Cluster lights for the business section of the city will probably be installed.

WHITE BLUFFS, WASH.—This place will soon install a system of lights and electric system. Several dynamos will be installed.

ELLENSBURG, WASH.—An expenditure of $3000 will be made for improvements to the local municipal light plant this year. Engineer Miller states that 2000 horsepower will be generated instead of 600.

KLAMATH FALLS, ORE.—A proposition has been presented by the Siskiyou Electric Power Company for a franchise to build a power line into Klamath Falls for lights and power purposes during the coming year.

EUGENE, ORE.—The Oregon Power Company, H. M. Byllesby Company operators, has purchased the electric light plant at the town of Coburg, in northern Lane county, and will supply that place with lights and electricity.

SALEM, ORE.—The Salem Board of Public Works has planned to have cluster lights along the principal streets of the city. The executive committee has been authorized to go ahead and have plans prepared for their installation.

EAGLE POINT, ORE.—Surveys have been completed for the establishment of an electric light plant here. A power station will be located on the falls of the Little Butte Creek. The present plans call for the completion of the project by fall.

FORT MASON, CAL.—Bids will be received at the office of the Quartermaster, San Francisco, until March 1 for constructing an addition to the power house and installing pumping machinery at the U. S. Army General Hospital, Presidio of San Francisco.

SAN LUIS OBISPO, CAL.—Manager G. L. Howard, representing the Gas & Electric Company, says that when the company derives its power from the Santa Cruz Mountains for electricity it will arrange to pipe natural gas from the Santa Maria field to this city.

GRANTS PASS, ORE.—The City Council has granted to A. W Butler of Minneapolis, P. B. Herman and E. L. Churchill of this city a 50-year franchise for a modern and up-to-date gas plant, the plant to be completed within 8 months. Plans are now being worked on and it is probable that actual construction will commence within 30 days.

NEEDLES, CAL.—E. H. Rose of Los Angeles has purchased the property of the Needles Light & Power Co., at this place. The plant is to be improved at once, the present plant being duplicated and a gas plant will be erected to be opated in connection with the plant.

SAN FRANCISCO, CAL.—At the annual meeting of the stockholders of the Pacific Lighting Corporation directors were elected as follows: George H. Collins, Charles Holbrook, C. O. G. Miller, A. Schilling and F. W. Sicklen. The directors organized by re-electing officers, namely: C. O. G. Miller, president; George H. Collins, vice-president, and Horace H. Miller, secretary. The Pacific Lighting Corporation succeeded the Pacific Lighting Company which was organized May 20, 1907, and is a holding company. It owns the entire outstanding stock of the Los Angeles Gas & Electric Corporation and practically the entire stock of the Pasadena Consolidated Gas Company, as well as other assets.

LOS ANGELES, CAL.—Following the election of permanent officers this week, the Southern California Gas Company, the $10,000,000 corporation that has taken over the business of the Domestic Gas Company, and which plans to build high pressure gas systems between Los Angeles and the cities of the San Bernardino Valley, will begin immediately work on a number of extensions. These officers will direct the affairs of the company: W. G. Kerckhoff, president; A. C. Balch, first vice-president; A. N. Kemp, second vice-president, and comptroller and I. M. Farman, secretary. The first work of magnitude to be undertaken is the extension of the Glendale distributing system. The company already has spent $100,000 in this work and the extension will cost about $50,000. Fully ten miles of pipe will be laid.

TRANSPORTATION.

SAN DIEGO, CAL.—The San Diego Electric Railway Company will soon extend its line to Escanto Heights. The M street car line also will be extended.

VALLEJO, CAL.—President T. Gregory of the Vallejo & Northern Electric Railway Company, has applied for a 50-year franchise for an electric line over the tide lands leading to the wharf of the Monticello Steamship Company.

HAYWARD, CAL.—I. B. Parsons, president of the Bank of Hayward, has purchased a franchise for a street railway to run from the Southern Pacific station via Front, C, Commercial and B streets ao the eastern city limits.

SACRAMENTO, CAL.—After the bill giving the right for the city of San Francisco to use any of the tracks of the United Railroads had been signed by the Governor it was found that the omission of two words, "an act," nullified its legality.

SAN FRANCISCO, CAL.—The Southern Pacific Railroad Company is receiving bids for the construction of a substation which is to be erected in Berkeley in connection with the electrifying of its ferry lines on that side of the bay. The work will be executed in reinforced concrete.

MARTINEZ, CAL.—Stating that the Oakland and Antioch Electric Railway Company intended to construct a scenic railroad to the summit of Mount Diablo, A. W. Maltby, one of the directors of the road, has asked the Board of Supervisors to grant his corporation a franchise for a line from Concord to a point known as Castle Rock, situated at the base of the famous mountain.

SEATTLE, WASH.—Plans of the Seattle Electric Company for the electrification of the Madison street cable line were made public when the Board of Public Works granted a permit for the reconstruction of the cable line between 21st avenue and Broadway last week. The plan, as explained by Chief Engineer Geo. J. James, means the running of cable cars between the water-front and Broadway.

ALAMEDA, CAL.—The installation of overhead wires from the Southern Pacific power house on the tidal canal to the poles throughout Alameda was commenced by a force of workmen this week, and railroad officials announce that the first electric trains would probably be in operation by June 1, by which time they expect the entire power system will be ready for work. The new steel passenger coaches are expected to arrive by the end of this month. The coaches will be practically wreck proof. They will be the same style as used on the subway in New York City.

STOCKTON, CAL.—The San Joaquin Valley Electric Railway Company, now that its franchise to French Camp via McKinley avenue is practically assured, announces that it will be carrying passengers and freight between Stockton and Modesto, via French Camp, Manteca, Ripon and Salida, by early summer. The company's newly graded roadbed between French Camp and Modesto was but little damaged by the high water. The new reinforced concrete bridge over the Stanislaus River at Ripon is well under course of construction and was only temporarily delayed by the high water of last week. The rails for the line have been secured and when the McKinley avenue franchise is formally awarded the work of grading between French Camp and Stockton will be taken up and the laying of rails will soon begin.

TELEPHONE AND TELEGRAPH.

DAYTON, WASH.—The board of directors of the Mt Vernon Telephone Company will receive bids up to March 1 for the furnishing of about 460 tamarack telephone poles along the line of the Mt. Vernon Telephone line from Granger mountain to this city, a distance of 12 miles. Further information on application to J. W. Stevens at Dayton, Wash.

SAN FRANCISCO, CAL.—The Pacific and Home telephone companies have presented their financial statements for the last six months to the Board of Supervisors and members of the Board questioned the representatives of the opposing companies on their services to the public. Accompanying the statement the Pacific Telephone & Telegraph Company requested the privilege of discontinuing the four-party lines. It was stated that the four-party lines interfered with other service, that it was being furnished at a direct loss to the company and that if it were discontinued the company could increase its service on other lines. Vice-President S. G. McMeen represented the Home Telephone Company. He said that his company was just making expenses and quoted figures from his statement as proof. He said the total earnings of the Home company for the six months ending December 31, 1910, was $174,945.47, their total expenses $149,866.19, leaving a net earning of $25,129.28.

WATERWORKS.

BAKERSFIELD, CAL.—A franchise has been granted by the Supervisors to Richard Hastings for a pipe line for water for the Lost Hills oil district and the new town of Lost Hills.

PLACERVILLE, CAL.—C. F. Peters has filed notice of the location of 100,000 inches of the water flowing in the middle fork of the Cosumnes river at a point to the west of the mouth of Perry Creek for power, irrigation, municipal and domestic purposes.

SAN DIEGO, CAL.—The Board of Supervisors has granted the petition of the property owners of San Ysidro colony for the organization of the San Ysidro irrigation district. Districts will be organized for the purpose of developing water to supply San Ysidro.

OAKLAND, CAL.—Persistent rumors to the effect that negotiations are in progress between the People's Water Company and the heads of the Bay Cities Water Company for the purchase and absorption of the former's plant by the latter concern are emphatically denied by officials of both corporations.

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